



Antony RAJA, INOPC - 08/08/2013

RET 670

Differential Protection



Antony RAJA, INOPC - 08/08/2013

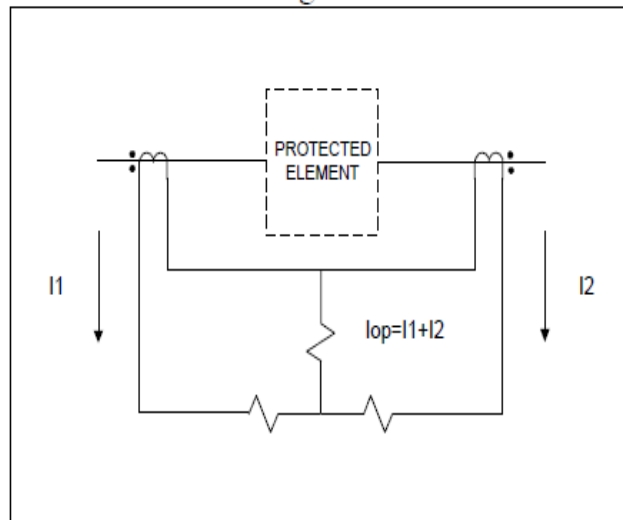
RET 670

Differential Protection Basics

BASIC CURRENT DIFFERENTIAL RELAYING

Current differential relaying is applied to protect many elements of a power system. The simplest example of a current differential relaying scheme is shown in Figure 1. The protected element might be a length of circuit conductor, a generator winding, a bus section, etc. From Figure 1 it can be seen that current differential relaying is a basic application of Kirchhoff's Current Law. The relay operates on the sum of the currents flowing in the CT secondaries, $I_1 + I_2$. For through current conditions, such as load or an external fault, the currents in the two CT's will be equal in magnitude and opposite in phase (assuming the CT's have the same ratio and are properly connected), and there will be no current flow in the relay operate coil [1].

Figure 1



Should a short circuit occur within the protected section between the two CT's, current will flow through the operate circuit causing the relay to issue a trip output.

To improve the selectivity and security of the current differential scheme, it is often designed as a percentage restraint differential relay. In a percentage restraint current differential relay, the operating current is the vector sum of the CT currents.

$$I_{\text{operate}} = | I_1 + I_2 |$$

This operating current must be greater than some percentage (K1) of the restraint quantity which is derived from the sum of the magnitude of the individual CT currents. A typical restraint current could be:

$$I_{\text{restraint}} = k * [| I_1 | + | I_2 |]$$

The operating characteristic of the percentage restraint current differential relay with a slope of K1 is shown in Figure 2.

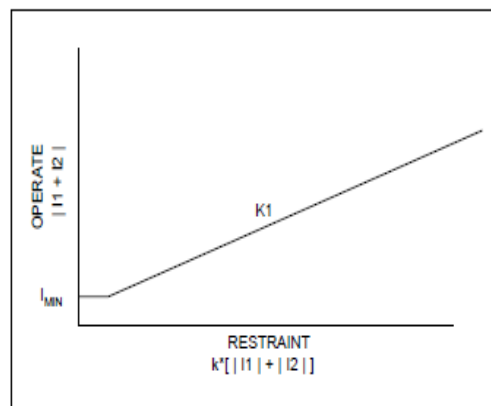
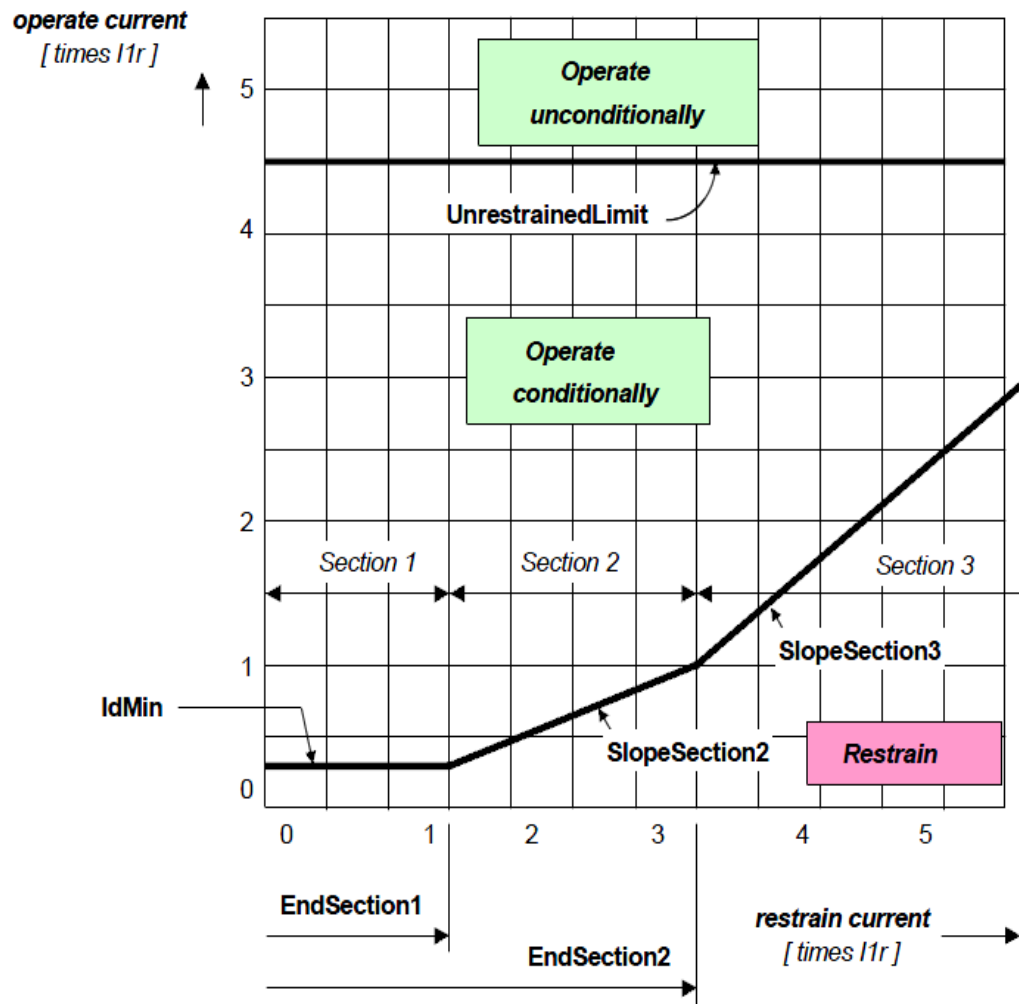


Figure 2

Operate - Restrain Differential Characteristics



Section 1: This is the most sensitive part on the characteristic. In section 1, normal currents flow through the protected circuit and its current transformers, and risk for higher false differential currents is relatively low. Un-compensated on-load tap-changer is a typical reason for existence of the false differential currents in this section. Slope in section 1 is always zero percent.

Section 2: In section 2, a certain minor slope is introduced which is supposed to cope with false differential currents proportional to higher than normal currents through the current transformers.

Section 3: The more pronounced slope in section 3 is designed to result in a higher tolerance to substantial current transformer saturation at high through-fault currents, which may be expected in this section.

The operate - restrain characteristic should be designed so that it can be expected that:

- for internal faults, the operate (differential) currents are always safely, i.e. with a good margin, above the operate - restrain characteristic
- for external faults, the false (spurious) operate currents are safely, i.e. with a good margin, below the operate - restrain characteristic

where:

$$slope = \frac{\Delta I_{operate}}{\Delta I_{restrain}} \cdot 100\%$$

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Differential Protection

Basics for Differential Protection

- ❑ Ratio compensation of injected current should match with the primary and secondary
- ❑ Phase Shift should be considered, as by default there will be a 180 phase shift
- ❑ Vector group is an important factor as to which vector group is selected for example d1(30) lag etc.

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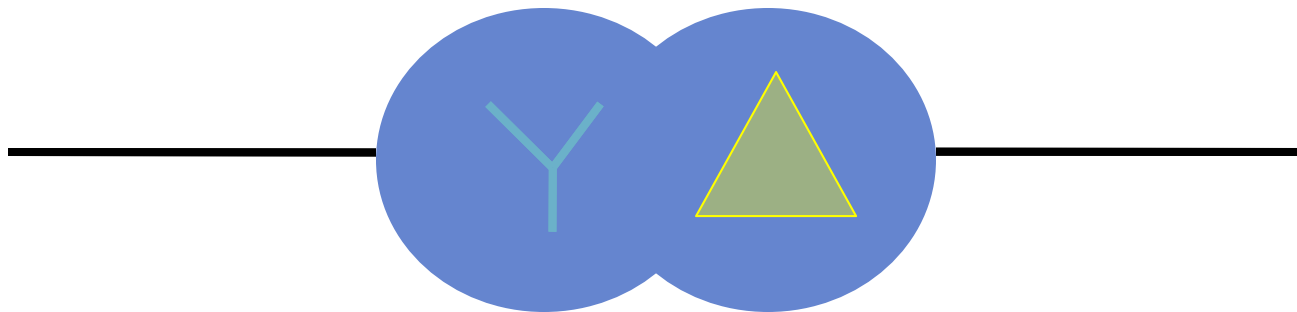
Differential Protection

For example let us consider a Star / Delta transformer of 220kV / 110kV and having a current of 800 / 2500A

220kV / 110kV

800/1 A

2500/1 A

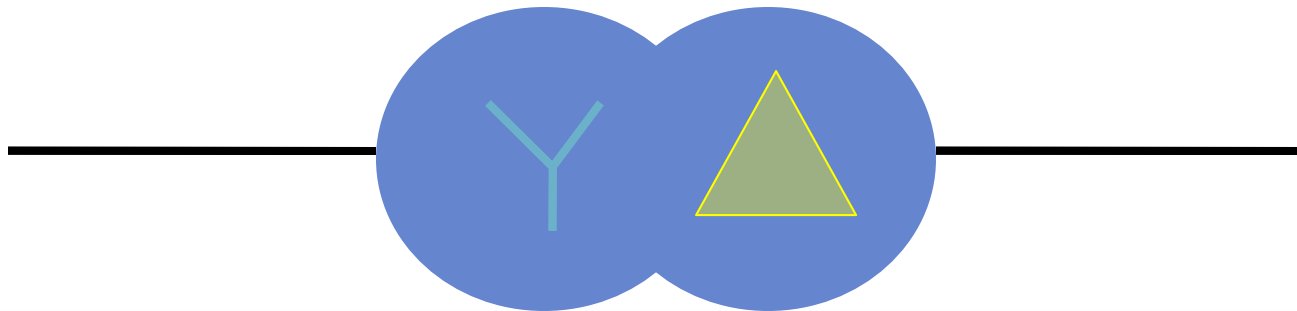


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Differential Protection

Condition 1 is satisfied i.e. Ratio Compensation

- For 100mA in primary the primary current is $800 \times 0.1 = 80\text{A}$
- But the secondary ratio is $2500 / 1$, so in order to match the secondary current with the primary we consider $2500 \times (X) = 80\text{A}$
i.e. $X = 80/2500 \Rightarrow \underline{32\text{mA}}$

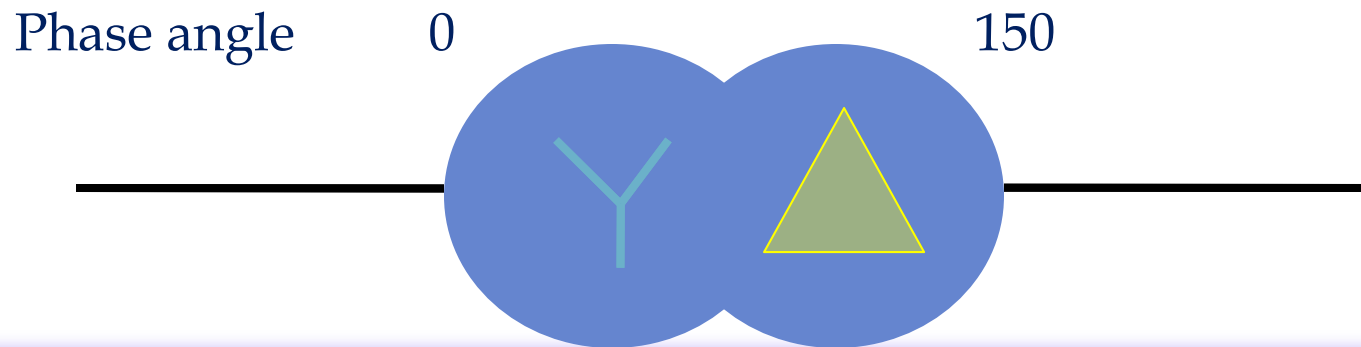


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Differential Protection

Condition 2 is satisfied i.e. Phase Shift by the specified vector group

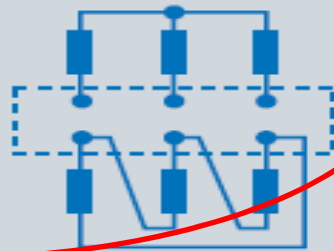
- The secondary is delta (DY1) and its 30 degrees lag from the primary, so the phase shift is $180-30 = 150$.
- So the phase angle that has to be set for primary is 0 and the secondary is 150 for R phase and so on.



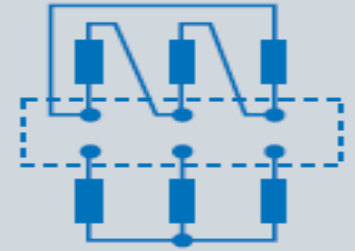
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Vector group

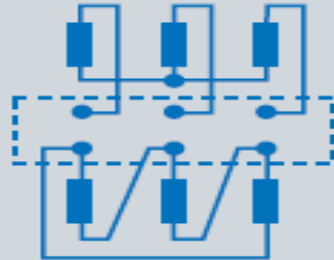
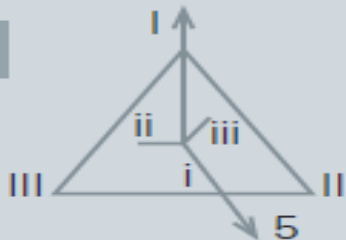
Dy1



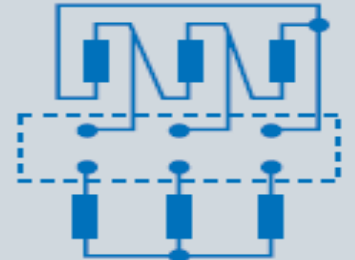
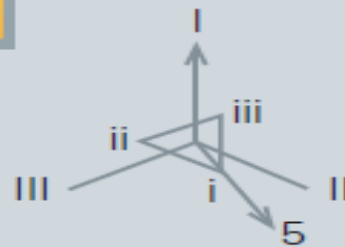
Yd1



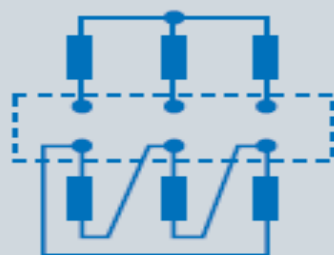
Dy5



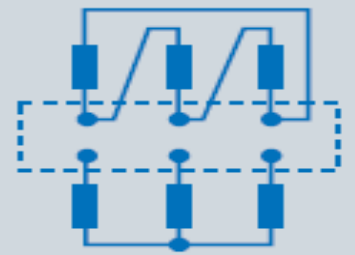
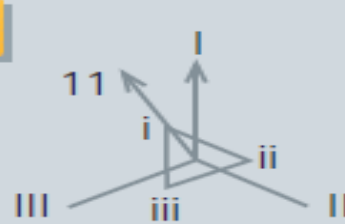
Yd5



Dy11



Yd11



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Differential Protection

- Using the CMC gives us the basic understanding of differential protection.
- The values of IBIAS & IDIFF can be checked in the relay by going to Test menu then to Function status then to Differential protection, then to TransformerDiff3wind.
- The testing can be performed by quick CMC by varying the values of magnitude and phase angle.

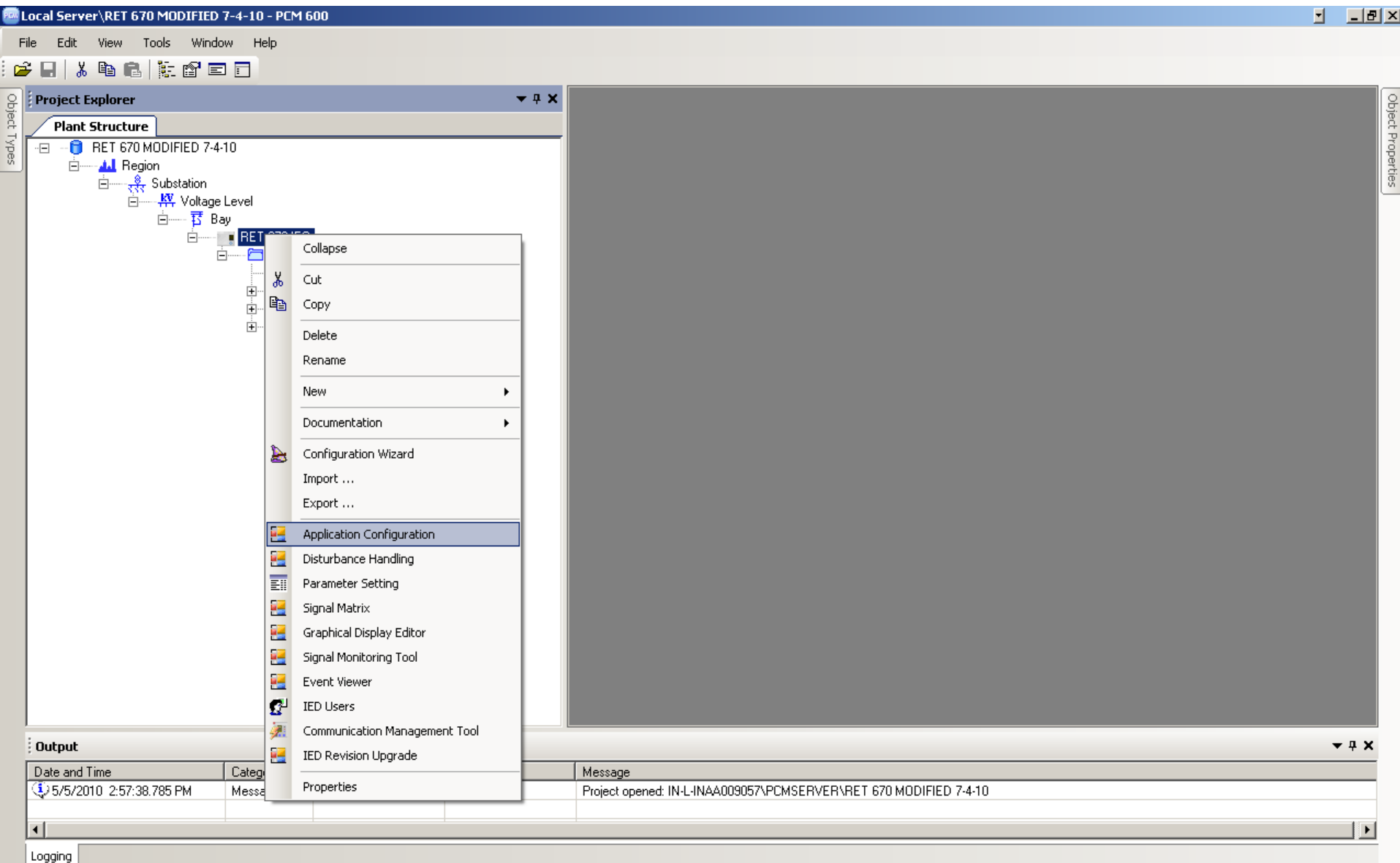


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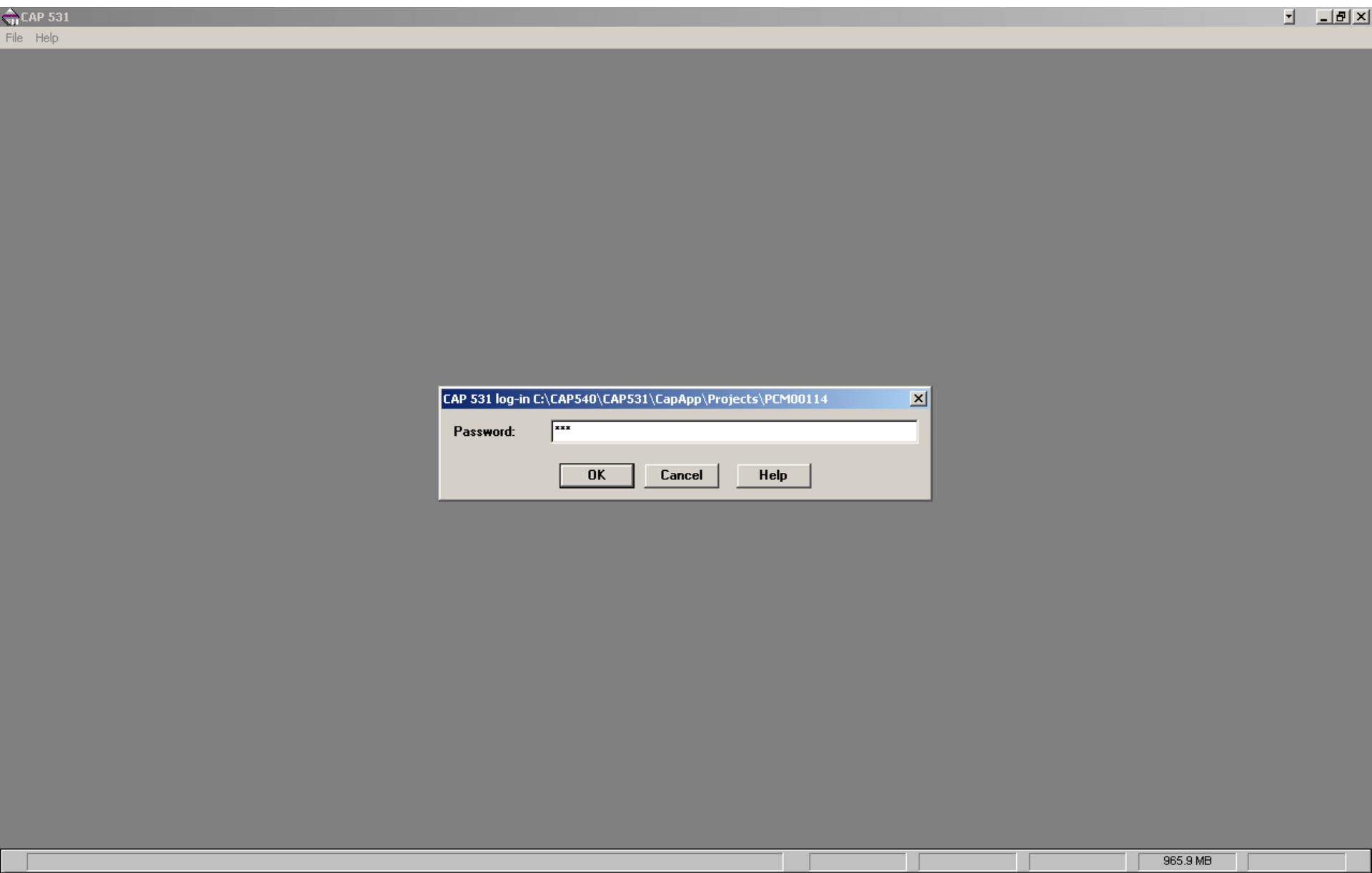
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Parameters settings, App Configuration tool, Testing of Differential using Omicron 356 in Quick CMC mode

RET 670 - ACT TOOL



RET 670 - ACT TOOL



RET 670 – CAP 531

CAP 531

File Edit Object Layout Make On-line Window Help

Project (1) : PCM00114

Work Sheet (1) : DIF_PROT

CT inputs for differential protection is from W1_CT1_A & W2_CT2_2

3-W DIFFERENTIAL PROTECTION

+

W1_CT1_A_I3P

GRP_OFF

W2_CT2_A_I3P

GRP_OFF

GRP_OFF

TCM1-TCPOS

TCM2-TCPOS

TCM1-POSERRAL

TCM2-POSERRAL

T3D1-(935,1)
T3WPDIF_87T

I3PW1CT1	TRIP
I3PW1CT2	TRIPRES
I3PW2CT1	TRIPUNRE
I3PW2CT2	TRNSUNR
I3PW3CT1	TRNSSENS
I3PW3CT2	START
TAPOLTC1	STL1
TAPOLTC2	STL2
OLTC1AL	STL3
OLTC2AL	BLK2H
FALSE	BLK2HL1
FALSE	BLK2HL2
FALSE	BLK2HL3
FALSE	BLK3H
FALSE	BLK3HL1
FALSE	BLK3HL2
FALSE	BLK3HL3

Insert setting parameter value

MARK

73/53

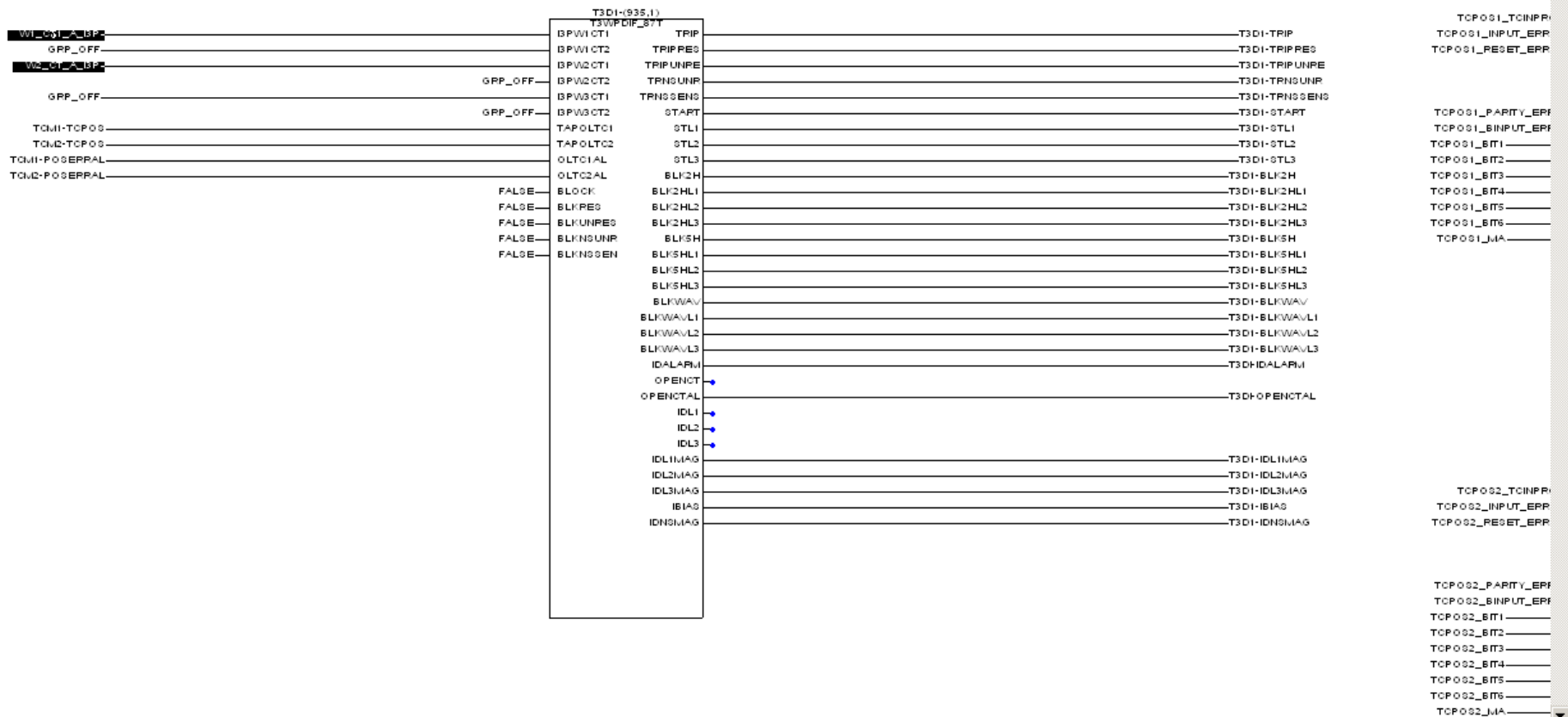
972.8 MB

EDIT

RET 670 - CAP 531



3-W DIFFERENTIAL PROTECTION



RET 670 - CAP 531

CAP 531 - [Work Sheet (1): DIF_PROT]

File Edit Object Layout Make On-line Window Help

3-W DIFFERENTIAL PROTECTION

W1_CT1_A_I3P
GRP_OFF
W2_CT_A_I3P
GRP_OFF
TCM1-TCPOS
TCM2-TCPOS
TCM1-POSERRAL
TCM2-POSERRAL

T3D1-(935,1)
T3WPDIF_87T
I3PW1CT1 TRIP
I3PW1CT2 TRIPRES
I3PW2CT1 TRIPUNRE

Global Find

Find What:
W1_CT1_A_I3P

☐ Match Whole Word Only
☐ Match Case
☐ Search Only In Marked Items

Find Next
Cancel
Help

BLKSHL2
BLKSHL3
BLKWAV
BLKWAVL1
BLKWAVL2
BLKWAVL3
IDALARM
OPENCT
OPENCTAL
IDL1
IDL2
IDL3
IDL1MAG
IDL2MAG
IDL3MAG
IBIAS
IDNSMAG

Global find entries or objects

MARK

114/0

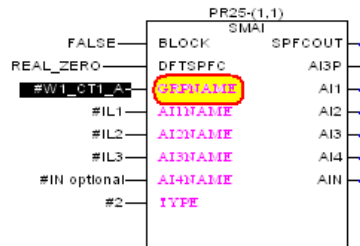
672.9 MB

EDIT

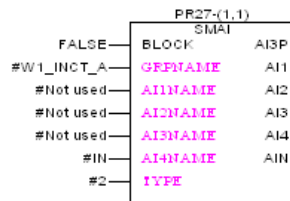
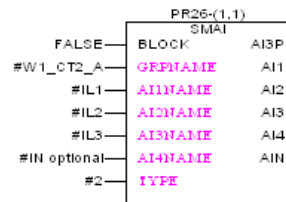
RET 670 – CAP 531



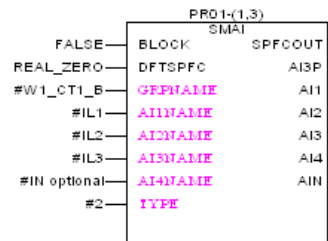
CURRENT CIRCUIT FOR DIFFERENTIAL & REF PROTECTION, WINDING 1 SIDE



Note down the GRPNAME so that it can be identified in the signal matrix



CURRENT CIRCUIT FOR BFP & IOC, WINDING 1 SIDE

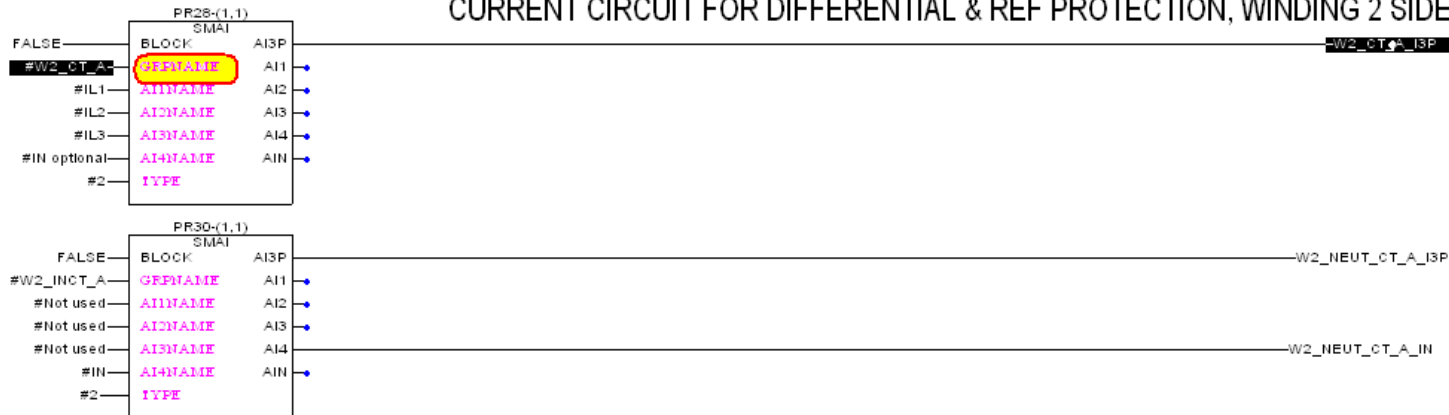


W1_CT1_B_IL1
W1_CT1_B_IL2
W1_CT1_B_IL3
W1_CT1_B_IN

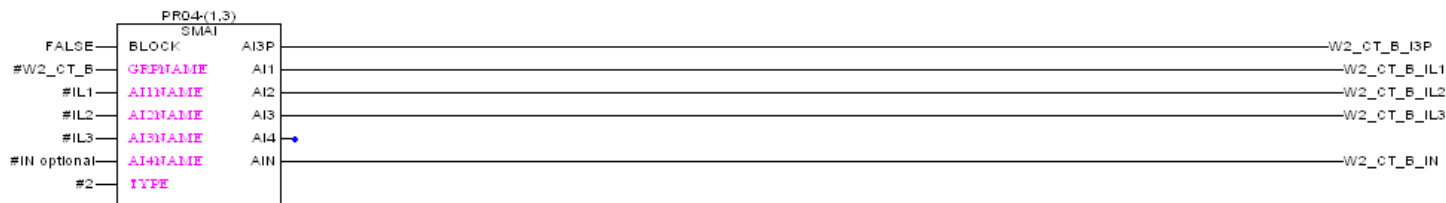
RET 670 – CAP 531



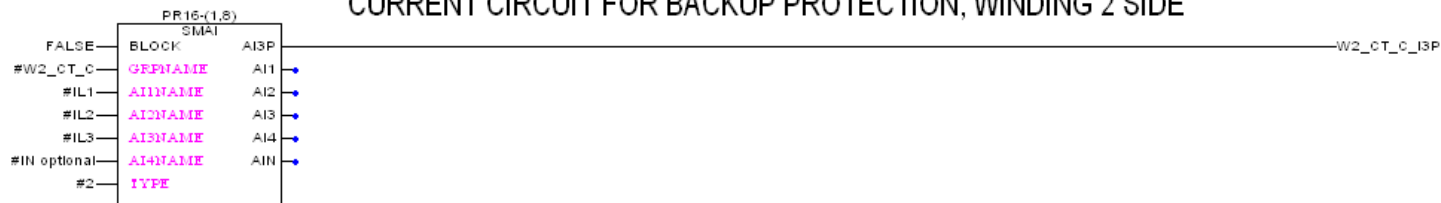
CURRENT CIRCUIT FOR DIFFERENTIAL & REF PROTECTION, WINDING 2 SIDE



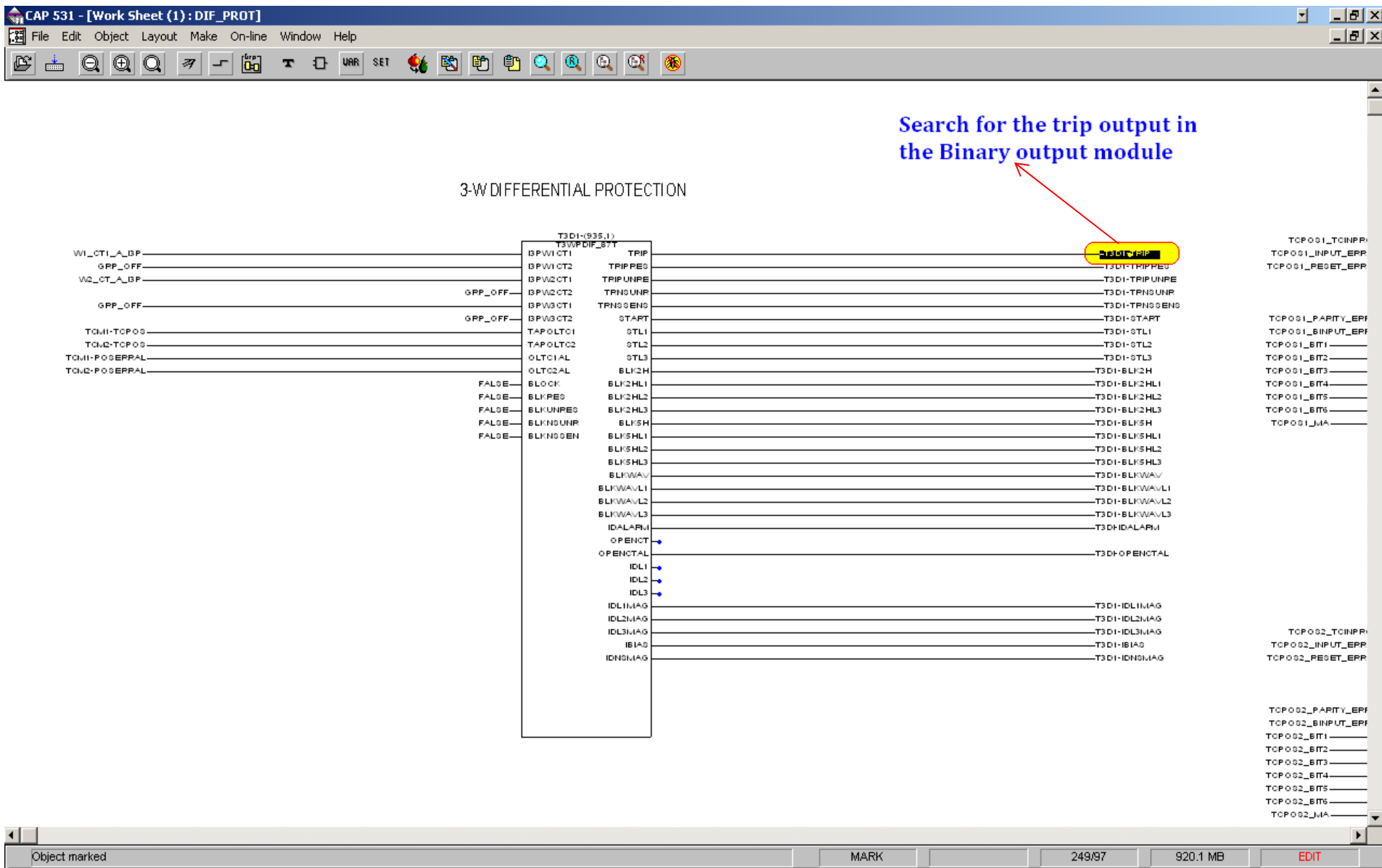
CURRENT CIRCUIT FOR BREAKER FAILURE PROTECTION & FUSE FAILURE SUPERVISION, WINDING 2 SIDE



CURRENT CIRCUIT FOR BACKUP PROTECTION, WINDING 2 SIDE



RET 670 - CAP 531



RET 670 - CAP 531

CAP 531 - [Work Sheet (3) : V_B0]

File Edit Object Layout Make On-line Window Help

T3D1-TRIP

T3D1-TRIPRES

T3D1-TRIPUNRE

T3D1-TRNSUNR

T3D1-TRNSSENS

T3D1-START

T3D1-DALARM

T3D1-OPENCAL

Note down the INSINAME so that the output can be mapped in signal matrix

T3D1-BLK2H

T3D1-BLK5H

T3D1-BLKWAV

W1_BUS_CB_BFP1-TRBU

W1_BUS_CB_BFP1-TRRET

W1_BUS_CB_PD1-TRIP

W1_TIE_CB_BFP2-TRBU

W1_TIE_CB_BFP2-TRRET

W1_TIE_CB_PD2-TRIP

S005-(4304,3)

SMBO

B01

B02

B03

B04

B05

B06

B07

B08

B09

B010

FALSE

FALSE

#DIFF PROT

#TRIP

#TRIP RESTRAIN

#TRIP UNRES

#TRIP NS UNRES

#TRIP NS SENS

#START

#IDIFF ALARM

#OPEN CT ALARM

#Not used

#Not used

S006-(4305,3)

SMBO

B01

B02

B03

B04

B05

B06

B07

B08

B09

B010

FALSE

FALSE

FALSE

FALSE

FALSE

FALSE

FALSE

FALSE

FALSE

#DIFF PROT

#I2 BLOCK

#I5 BLOCK

#BLOCK WAV

#Not used

#Not used

#Not used

#Not used

#Not used

#Not used

S007-(4306,3)

SMBO

B01

B02

B03

B04

B05

B06

B07

B08

B09

B010

FALSE

FALSE

FALSE

FALSE

#W1 BFP PROT

#BUS CB TRP BU

#BUS CB RETRIP

#BUS CB PD TRP

#TIE CB TRP BU

S008-(4307,3)

INSINAME

BO1NAME

BO2NAME

BO3NAME

BO4NAME

BO5NAME

BO6NAME

BO7NAME

BO8NAME

BO9NAME

BO10NAME

INSINAME

BO1NAME

BO2NAME

BO3NAME

BO4NAME

BO5NAME

BO6NAME

BO7NAME

BO8NAME

BO9NAME

BO10NAME

INSINAME

BO1NAME

BO2NAME

BO3NAME

BO4NAME

BO5NAME

BO6NAME

BO7NAME

BO8NAME

BO9NAME

BO10NAME

Object marked

MARK

412/132

1042.3 MB

EDIT

RET 670 - Signal Matrix

Local Server\RET 670 LAB PRATC - PCM 600

File Edit View Tools Window Help

Object Types

Project Explorer

Plant Structure

- RET 670 LAB PRATC
 - Region
 - Substation
 - Voltage Level
 - Bay
 - RE

Expand

Cut

Copy

Delete

Rename

New

Documentation

Configuration Wizard

Import ...

Export ...

Application Configuration

Disturbance Handling

Parameter Setting

Signal Matrix

Graphical Display Editor

Signal Monitoring Tool

Event Viewer

IED Users

Communication Management Tool

IED Revision Upgrade

Properties

Output

Date and Time	Category	Message
5/6/2010 10:00:27.679 AM	Warning	No goose receive logical devices found.
5/6/2010 10:00:28.429 AM	Warning	[local]\admin - Syste... RET 670 IEC No goose receive data configured!

Logging

Thursday, May 06, 2010 10:01:09 AM

ABB

RET 670 - Signal Matrix

Local Server\RET 670 LAB PRATC - PCM 600

File Edit View Tools IED Signal Matrix Reports Window Help

Object Types

Project Explorer

Plant Structure

- RET 670 LAB PRATC
 - Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC

RET 670 IEC - Signal Matr...

TRM_9I_3U Slot 31 /X0

	1	2	3	4	5	6	7	8	9	10	11	12		1	2	3	4	5	6	7	8	9	10	11	12
	CT	CT	CT	CT	CT	CT	CT	CT	CT	VT	VT	VT		CT	CT	CT	CT	CT	CT	CT	CT	VT	VT	VT	
UL3																									
Not used																									
- W1_CT1_A (25)	IL1	X																							
	IL2		X																						
	IL3			X																					
IN optional																									
- W1_CT2_A (26)	IL1													X											
	IL2														X										
	IL3															X									
IN optional																									
- W1_INCT_ (27)	Not used																								
	Not used																								
	Not used																								
IN									X																
- W2_CT_A (28)	IL1				X																				
	IL2					X																			
	IL3						X																		
IN optional																									
- W2_INCT_ (30)	Not used																								
	Not used																								
	Not used																								
IN										X															
TCPOS1 M (1)	MILLI AMP INP																								
TCPOS2 M (2)	MILLI AMP INP																								
- HZD (10)	HZD_R																					X			

Binary Inputs / Binary Outputs / Analog Inputs

Output

Date and Time	Category	User	Object	Message
5/6/2010 10:01:11.866 AM	Warning	[local]\admin - Syste...	T670_I	No goose receive logical devices found.
5/6/2010 10:01:12.616 AM	Warning	[local]\admin - Syste...	RET 670 IEC	No goose receive data configured!

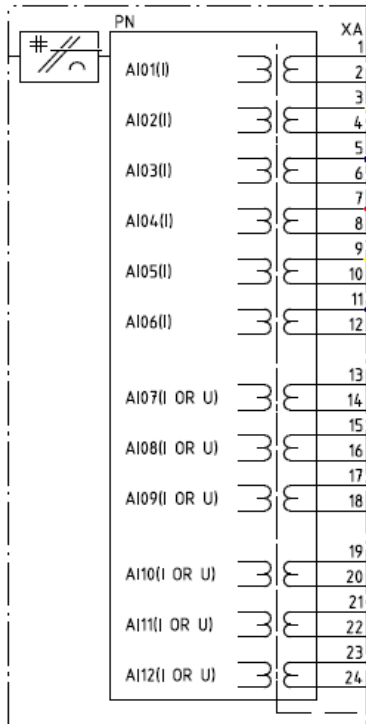
Logging

Thursday, May 06, 2010 10:02:09 AM

ABB

CT Connections between the IED and Omicron 356

RET 670 IED



OMICRON 356



Before switching the power ON, make sure that the IED & Omicron is earthed

RET 670 - Signal Matrix

Local Server\RET 670 LAB PRATC - PCM 600

File Edit View Tools IED Signal Matrix Reports Window Help

Project Explorer

Plant Structure

- RET 670 LAB PRATC
 - Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC

RET 670 IEC - Signal Matr...

BOM Slot 4 / X0

BLOCK XA 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 XB 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
CB CLOSED																								
SPRING UNCH																								
CB EXT TRIP																								
OF_TRIP																								
UF_TRIP																								
ROC_TRIP																								
- W3 CB (4)																								
TRIP CB																								
TRIP LOCKOUT																								
TCS ALARM																								
CB CLOSED																								
SPRING UNCH																								
CB EXT TRIP																								
OVEX_TRIP																								
OVEX_ALARM																								
- DIFF PRO (5)																								
TRIP																								
TRIP RESTRAIN																								
TRIP UNRES																								
TRIP NS UNRES																								
DIFF PROT (5) NS SENS																								
START																								
IDIFF ALARM																								
OPEN CT ALARM																								
- DIFF PRO (6)																								
I2 BLOCK																								
I5 BLOCK																								
BLOCK WAV																								

Binary Inputs Binary Outputs Analog Inputs

Output

Date and Time	Category	User	Object	Message
5/6/2010 10:01:11.866 AM	Warning	[local]\admin - Syste...	T670_I	No goose receive logical devices found.
5/6/2010 10:01:12.616 AM	Warning	[local]\admin - Syste...	RET 670 IEC	No goose receive data configured!

Logging

Thursday, May 06, 2010 10:04:41 AM

ABB

Feedback from IED to Omicron

Connection for feedback from IED to Omicron

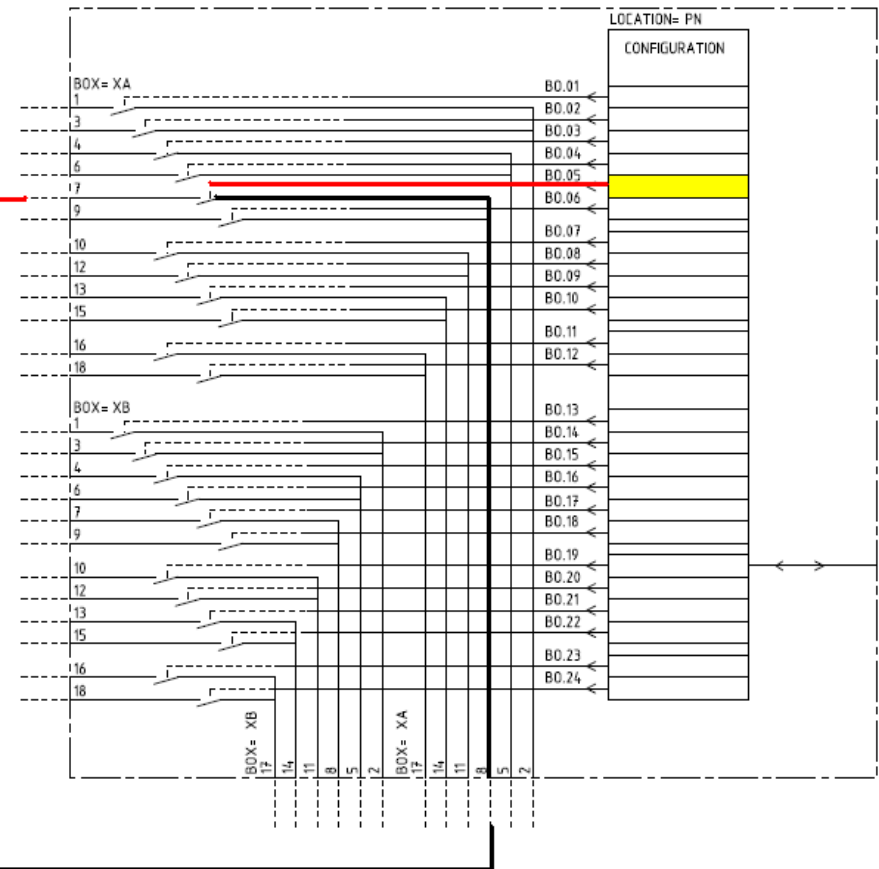
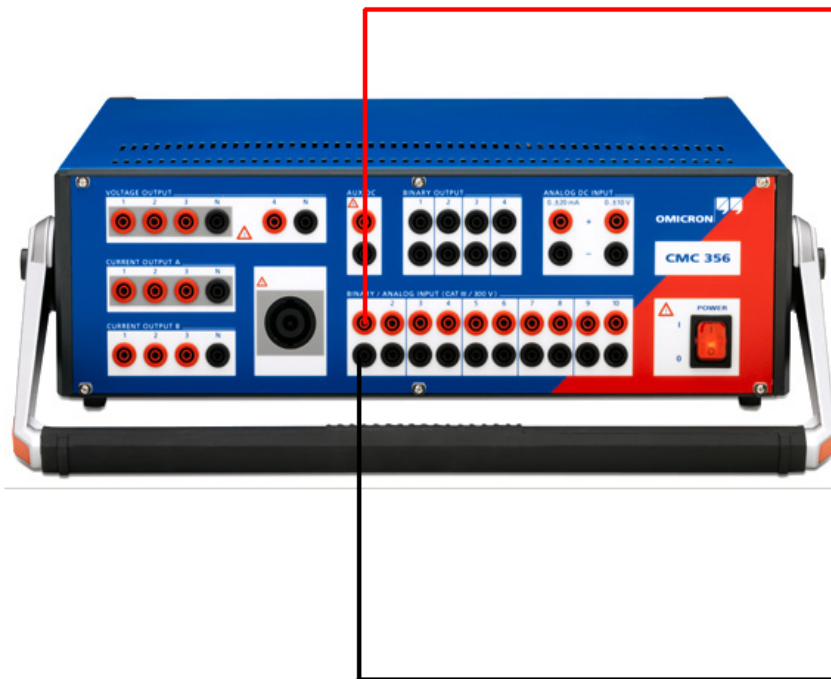


Figure 25: Binary output module (BOM). Output contacts named XA corresponds to rear position X31, X41 etc. and output contacts named XB to rear position X32, X42, etc.

RET 670 - CT RATIO

The screenshot displays the ABB RET 670 IEC software interface. On the left, the Project Explorer shows the plant structure under 'RET 670 LAB 24-03-10'. The main window, titled 'RET 670 IEC - Parameter ...', contains a table of parameters. Three rows are highlighted with red rectangles: CTsec1, CTprim1; CTsec2, CTprim2; and CTsec3, CTprim3. The bottom panel shows the Output window with 'Logging' selected.

Group / Parameter Name	IED Value	PC Value	Unit	Min	Max
NAMECH1		TRM40-CH1			13 character(s)
RatedTrans1		1.0	A	0.1	300.0
CTStarPoint1		ToObject			
CTsec1		1	A	1	10
CTprim1		800	A	1	99999
NAMECH2		TRM40-CH2			13 character(s)
RatedTrans2		1.0	A	0.1	300.0
CTStarPoint2		ToObject			
CTsec2		1	A	1	10
CTprim2		800	A	1	99999
NAMECH3		TRM40-CH3			13 character(s)
RatedTrans3		1.0	A	0.1	300.0
CTStarPoint3		ToObject			
CTsec3		1	A	1	10
CTprim3		800	A	1	99999
NAMECH4		TRM40-CH4			13 character(s)
RatedTrans4		1.0	A	0.1	300.0
CTStarPoint4		ToObject			
CTsec4		1	A	1	10
CTprim4		2500	A	1	99999
NAMECH5		TRM40-CH5			13 character(s)
RatedTrans5		1.0	A	0.1	300.0
CTStarPoint5		ToObject			
CTsec5		1	A	1	10

RET 670 - CT RATIO

Local Server\RET 670 MODIFIED 7-4-10 - PCM 600

File Edit View Tools IED Window Help

Object Types

Plant Structure

- Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Power system
 - Communication
 - Analog modules
 - AnalogInputs9land3U 1
 - AnalogInputs9land3U 2
 - Reference channel service values
 - 3PhaseAnalogGroup
 - 3PhAnalogSummationGroup
 - I/O modules
 - HMI
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1
 - Current protection
 - Voltage protection
 - Control
 - Monitoring
 - Metering
 - Setting group N1
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1
 - LowImpREF(PDIF,87N)
 - HighImpDifferential(PDIF,87)

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|-----------|------|-----|-----------------|
| NAMECH3 | | TRM40-CH3 | | | 13 character(s) |
| RatedTrans3 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint3 | | ToObject | | | |
| CTsec3 | | 1 | A | 1 | 10 |
| CTprim3 | | 800 | A | 1 | 99999 |
| NAMECH4 | | TRM40-CH4 | | | 13 character(s) |
| RatedTrans4 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint4 | | ToObject | | | |
| CTsec4 | | 1 | A | 1 | 10 |
| CTprim4 | | 2500 | A | 1 | 99999 |
| NAMECH5 | | TRM40-CH5 | | | 13 character(s) |
| RatedTrans5 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint5 | | ToObject | | | |
| CTsec5 | | 1 | A | 1 | 10 |
| CTprim5 | | 2500 | A | 1 | 99999 |
| NAMECH6 | | TRM40-CH6 | | | 13 character(s) |
| RatedTrans6 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint6 | | ToObject | | | |
| CTsec6 | | 1 | A | 1 | 10 |
| CTprim6 | | 2500 | A | 1 | 99999 |
| NAMECH7 | | TRM40-CH7 | | | 13 character(s) |
| RatedTrans7 | | 1.0 | A | 0.1 | 300.0 |

Output

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Logging

Tuesday, May 04, 2010 3:16:05 PM **ABB**

Using Omicron

OMICRON Start Page

TEST UNIVERSE V2.30

Get Support | Customer Area

www.omicron.at | www.omicronusa.com

Test Modules
Stand-alone Startup

- QuickCMC** (highlighted in yellow)
- Ramping...
- State Sequencer
- Advanced TransPlay
- Overcurrent Distance...
- Autoreclosure Differential...
- Synchronizer
- Annunciation Checker
- Network Simulation...
- Meter
- Transducer
- PQ Signal Generator
- IEC 61850...
- CB Configuration

Control Center
Create Multifunctional Test Documents

- Open Existing Test Document
- Open Protection Testing Library
- Open Generic Template
- New Test Document

Test Administration
Relay and Test Database

TestBase

Test Tools
Additional Applications:

- TransPlay
- EnerLyzer
- TransView
- Harmonics
- Binary I/O Monitor
- Polarity Checker
- O/C Characteristics Grabber
- Scheme Testing Tools...
- AuxDC

Setup
Prepare Test Equipment

- Test Set Association
- System Settings
- License Manager
- Language Selection

Support
Documentation and Assistance

- Tutorials
- Manuals
- Help
- Tips & Tricks
- Contacts
- OMICRON Assist
- Diagnosis & Calibration...
- What's New

Custom
User-specific Tools

Select Quick CMC

QuickCMC - Virtual Front Panel Control. Right-click for more help.

Using Omicron

OMICRON QuickCMC - [Test View: QuickCMC1]

File Edit View Test Parameters Window Help

Set Mode: Direct

| Analog outputs | | | |
|----------------|---------|-----------|-----------|
| V L1-E | 0.000 V | 0.00 ° | 60.000 Hz |
| V L2-E | 0.000 V | -120.00 ° | 60.000 Hz |
| V L3-E | 0.000 V | 120.00 ° | 60.000 Hz |
| IL1 | 0.000 A | 0.00 ° | 60.000 Hz |
| IL2 | 0.000 A | -120.00 ° | 60.000 Hz |
| IL3 | 0.000 A | 120.00 ° | 60.000 Hz |

Binary Outputs

- Bin. out 1 ☐
- Bin. out 2 ☐
- Bin. out 3 ☐
- Bin. out 4 ☐
- Bin. Out 5 ☐
- Bin. Out 6 ☐
- Bin. Out 7 ☐
- Bin. Out 8 ☐

F10 F9

On Trigger

☒ Switch off Delay: 0.000 s

Step / Ramp

Output: V L1-E Size: 0.000 V ☐ Auto Step

Quantity: Magnitude Time: 1.000 s

☐ Pulse Ramp Reset: 500.0 ms

1.0 kVA +90° 1.0 kΩ

180° 0°

69.3 V 15.0 A

-90°

Analog Inputs

Vdc: 0.000 V Idc: 0.0000 mA

Binary Inputs / Trigger

| Trip | | | |
|----------|-------------------------------------|--------------------------|-----|
| Start | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |
| Not used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Overload | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |

Select the hardware configuration tool.

(ENG020) No CMC is connected to PC.

(ENG020) No CMC is connected to PC.

Using Omicron

OMICRON QuickCMC - [Test View: QuickCMC1]

File Edit View Test Parameters Window Help

Hardware Configuration

General Analog Outputs Binary / Analog Inputs Binary Outputs DC Analog Inputs

Set Mode Analog output Direct

| Set Mode | Analog output | Direct |
|----------|---------------|---------|
| V L1-E | 0.000 V | 0.00 |
| V L2-E | 0.000 V | -120.00 |
| V L3-E | 0.000 V | 120.00 |
| IL1 | 0.000 A | 0.00 |
| IL2 | 0.000 A | -120.00 |
| IL3 | 0.000 A | 120.00 |

Output Signal

| Test Module | Display Name | Connection | CMC356 V A | CMC356 V B | CMC356 I A | CMC356 I B | | | | | | | | | |
|---------------|--------------|------------|------------|------------|------------|------------|----|---|---|---|----|---|---|---|----|
| Output Signal | Terminal | 1 | 2 | 3 | II | 1 | II | 1 | 2 | 3 | II | 1 | 2 | 3 | II |
| V L1-E | V L1-E | X | | | | | | | | | | | | | |
| Not used | V L2-E | | X | | | | | | | | | | | | |
| V L1-E | V L3-E | | | X | | | | | | | | | | | |
| V E | V(2)-1 | | | | | X | | | | | | | | | |
| V Fault | IL1 | | | | | | X | | | | | | | | |
| V 0 | IL2 | | | | | | | X | | | | | | | |
| V(1)-1 | IL3 | | | | | | | | X | | | | | | |
| V(2)-1 | I(2)-1 | | | | | | | | | | X | | | | |
| V(3)-1 | I(2)-2 | | | | | | | | | | | X | | | |
| V(4)-1 | I(2)-3 | | | | | | | | | | | | X | | |
| Not used | I(2)-3 | | | | | | | | | | | | | X | |

Step / Ramp

Output: V L1-E

Quantity: Magnitude

☐ Pulse Ramp

On Trigger ☒ Switch

OK Cancel Apply Help

(ENG020) No CMC is connected to PC.

(ENG020) No CMC is connected to PC.

- Select Analog Outputs tab and select not used option for all the 3 voltages , IL2, IL3, I(2)-2 & I(3)-3.
- After finishing the selection select APPLY & OK for applying the settings

Using Omicron

OMICRON QuickCMC - [Test View: QuickCMC1]

File Edit View Test Parameters Window Help

Hardware Configuration

General Analog Outputs Binary / Analog Inputs Binary Outputs DC Analog Inputs

| Analog output | | | CMC356 V A | | | | CMC356 V B | | CMC356 I A | | | | CMC356 I B | | | |
|---------------|--------------|---------------------|------------|---|---|----|------------|----|------------|---|---|----|------------|---|---|----|
| Set Mode | Direct | | ?????? | | | | ?????? | | ?????? | | | | ?????? | | | |
| Output Signal | Display Name | Connection Terminal | 1 | 2 | 3 | II | 1 | II | 1 | 2 | 3 | II | 1 | 2 | 3 | II |
| V L1-E | 0.000 V | 0.00 | X | | | | | | | | | | | | | |
| V L2-E | 0.000 V | -120.00 | | X | | | | | | | | | | | | |
| V L3-E | 0.000 V | 120.00 | | | X | | | | | | | | | | | |
| IL1 | 0.000 A | 0.00 | | | | | X | | | | | | | | | |
| IL2 | 0.000 A | -120.00 | | | | | | X | | | | | | | | |
| IL3 | 0.000 A | 120.00 | | | | | | | X | | | | | | | |
| Not used | V L1-E | | X | | | | | | | | | | | | | |
| Not used | V L2-E | | | X | | | | | | | | | | | | |
| Not used | V L3-E | | | | X | | | | | | | | | | | |
| Not used | V(2)-1 | | | | | | X | | | | | | | | | |
| IL1 | IL1 | | | | | | | X | | | | | | | | |
| Not used | IL2 | | | | | | | | X | | | | | | | |
| Not used | IL3 | | | | | | | | | X | | | | | | |
| I(1)-1 | I(1)-1 | | | | | | | | | | | X | | | | |
| Not used | I(2)-2 | | | | | | | | | | | | X | | | |
| Not used | I(2)-3 | | | | | | | | | | | | | X | | |

Output: V L1-E

Quantity: Magnitude

Pulse Ramp

OK Cancel Apply Help

[ENG020] No CMC is connected to PC.

Using Omicron

OMICRON QuickCMC - [Test View: QuickCMC1]

File Edit View Test Parameters Window Help

Analog outputs

| Set Mode | Direct | | |
|----------|----------|--------|-----------|
| I L1 | 100.0 mA | 0.00 ° | 50.000 Hz |
| I(1)-1 | 32.00 mA | 0.00 ° | 50.000 Hz |

Binary Outputs

- Bin. out 1 ☐
- Bin. out 2 ☐
- Bin. out 3 ☐
- Bin. out 4 ☐
- Bin. Out 5 ☐
- Bin. Out 6 ☐
- Bin. Out 7 ☐
- Bin. Out 8 ☐

F10 F9

On Trigger

☒ Switch off Delay: 0.000 s

Step / Ramp

Output: I L1 Size: 0.000 A ☐ Auto Step

Quantity: Magnitude Time: 1.000 s

☐ Pulse Ramp Reset: 500.0 ms

Analog Inputs

Vdc: 0.000 V Idc: 0.0000 mA

Binary Inputs / Trigger

| Trip | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |
|----------|-------------------------------------|--------------------------|-----|
| Start | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |
| Not used | | | |
| Not used | | | |
| Not used | | | |
| Not used | | | |
| Not used | | | |
| Not used | | | |
| Not used | | | |
| Overload | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |

69.3 V 32.0 A

1.0 kVA 1.0 kVA

450° 180° 0° -90°

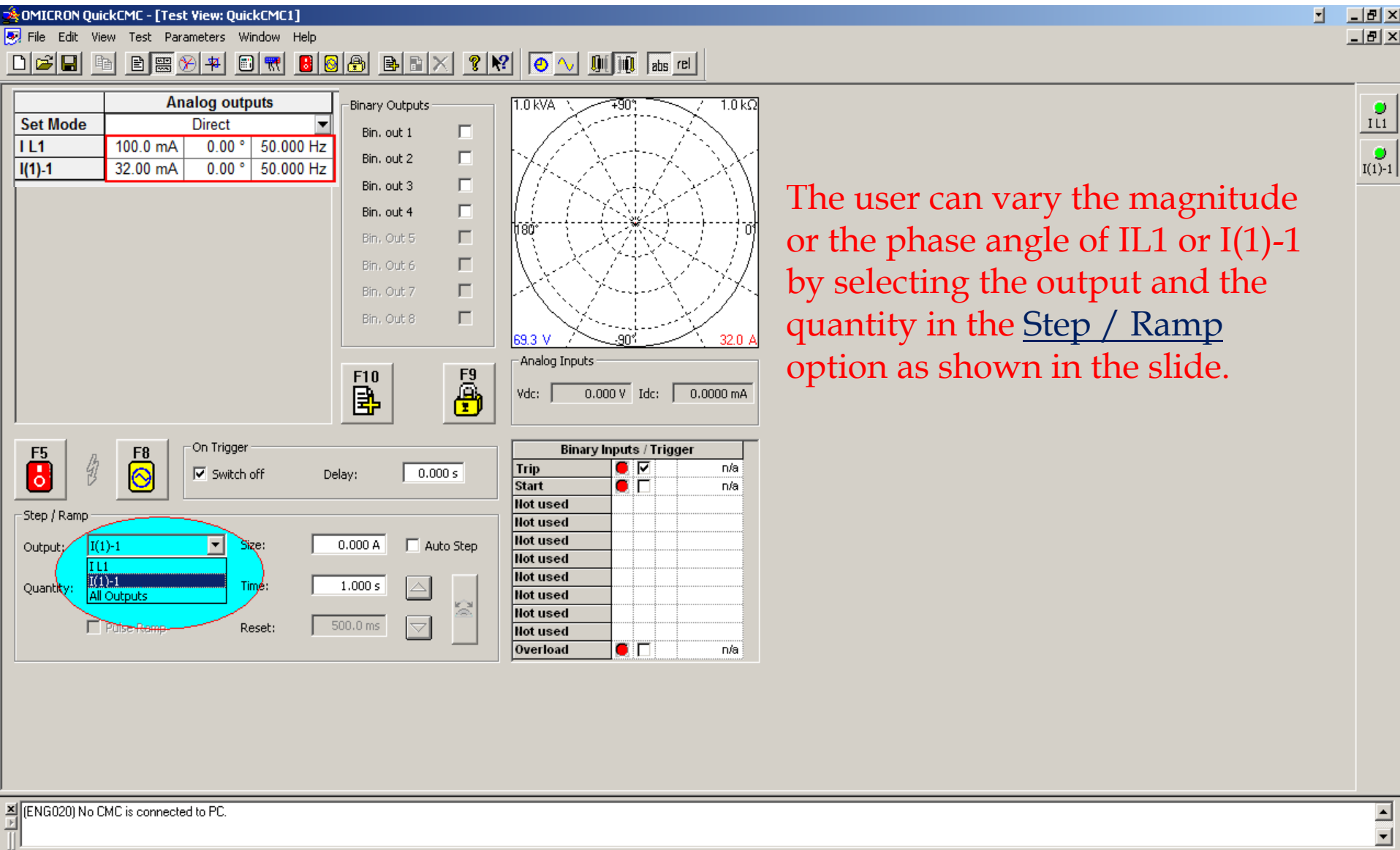
IL1 I(1)-1

➤ Make sure that the frequency is set to 50Hz as the default value the omicron takes is 60Hz.

➤ The magnitude & phase angle is selected via the CT & vector group calculation

(ENG020) No CMC is connected to PC.

Using Omicron



Using Omicron

OMICRON QuickCMC - [Test View: QuickCMC1]

File Edit View Test Parameters Window Help

Set Mode: Direct

| Analog outputs | | | |
|----------------|----------|----------|-----------|
| IL1 | 100.0 mA | 0.00 ° | 50.000 Hz |
| I(1)-1 | 32.00 mA | 150.00 ° | 50.000 Hz |

Binary Outputs:

- Bin. out 1 ☐
- Bin. out 2 ☐
- Bin. out 3 ☐
- Bin. out 4 ☐
- Bin. Out 5 ☐
- Bin. Out 6 ☐
- Bin. Out 7 ☐
- Bin. Out 8 ☐

F10 F9

On Trigger: ☒ Switch off Delay: 0.000 s

Step / Ramp:

Output: IL1 Size: 0.000 A ☐ Auto Step

Quantity: Magnitude Time: 1.000 s

☐ Pulse Ramp Reset: 500.0 ms

69.3 V 32.0 A

1.0 kVA 1.0 kΩ

Binary Inputs / Trigger:

| Trip | | | |
|----------|-------------------------------------|--------------------------|-----|
| Start | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |
| Not used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Not used | <input type="checkbox"/> | <input type="checkbox"/> | |
| Overload | <input checked="" type="checkbox"/> | <input type="checkbox"/> | n/a |

To Start / Stop the test function key F5 key is used.

F5 Outputs ON/OFF

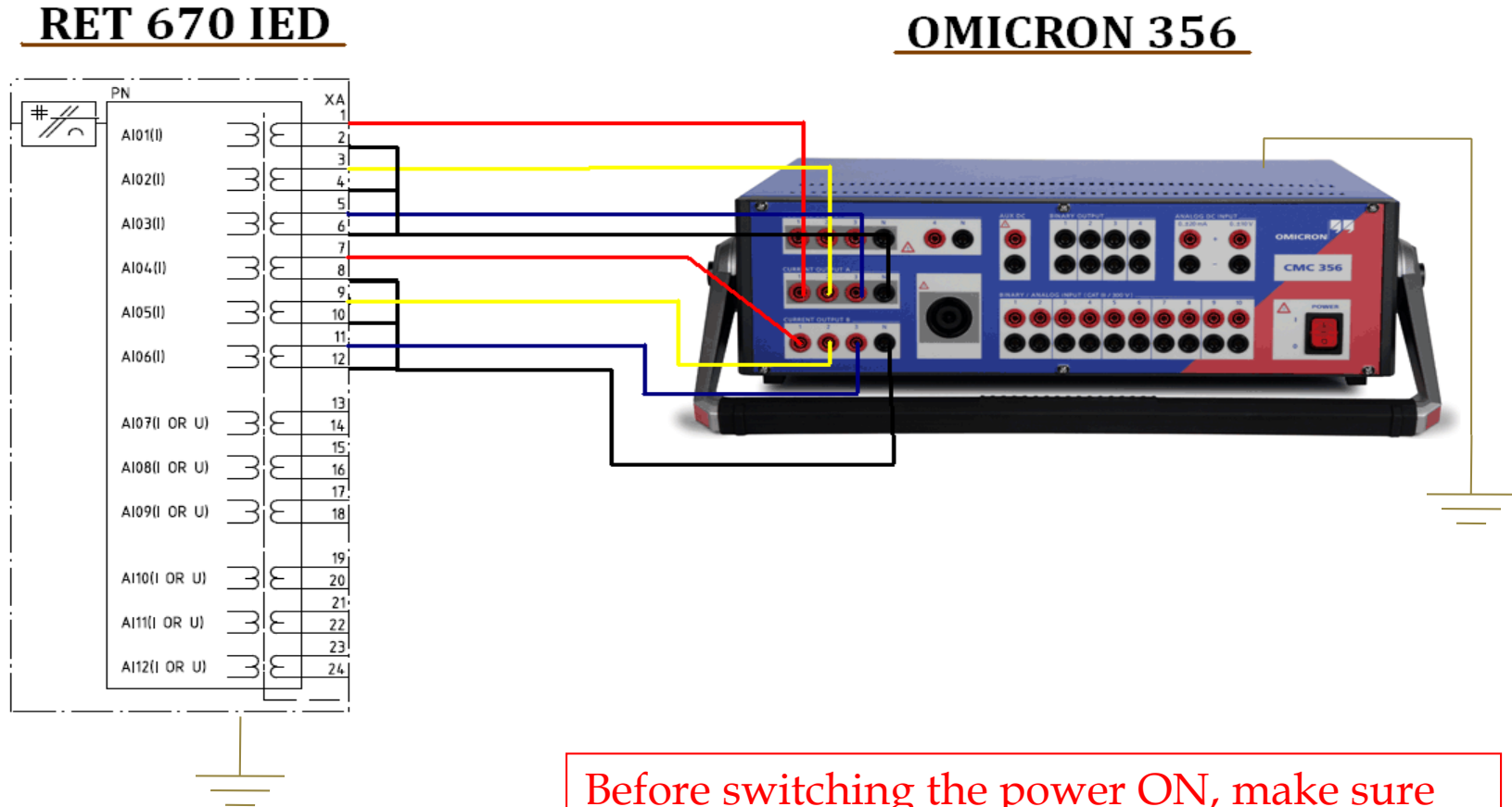
F8

(ENG020) No CMC is connected to PC.

(ENG020) No CMC is connected to PC.

RET 670

CT Connections between the IED and Omicron 356



Before switching the power ON, make sure that the IED & Omicron is earthed

Feedback from IED to Omicron

Connection for feedback from IED to Omicron

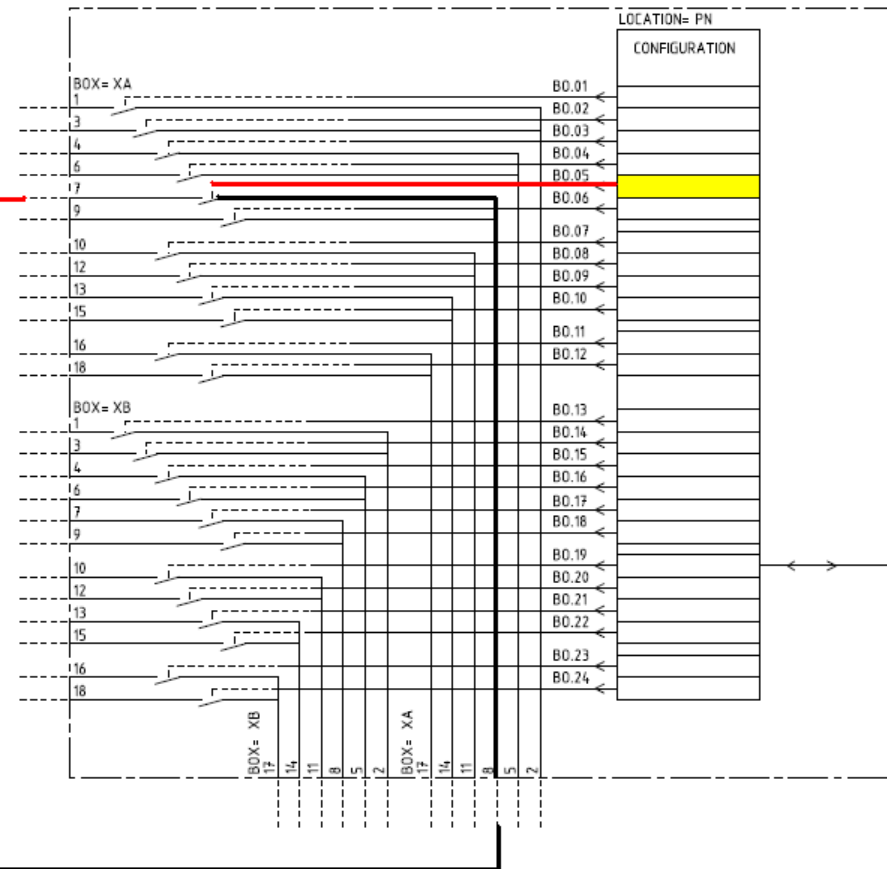
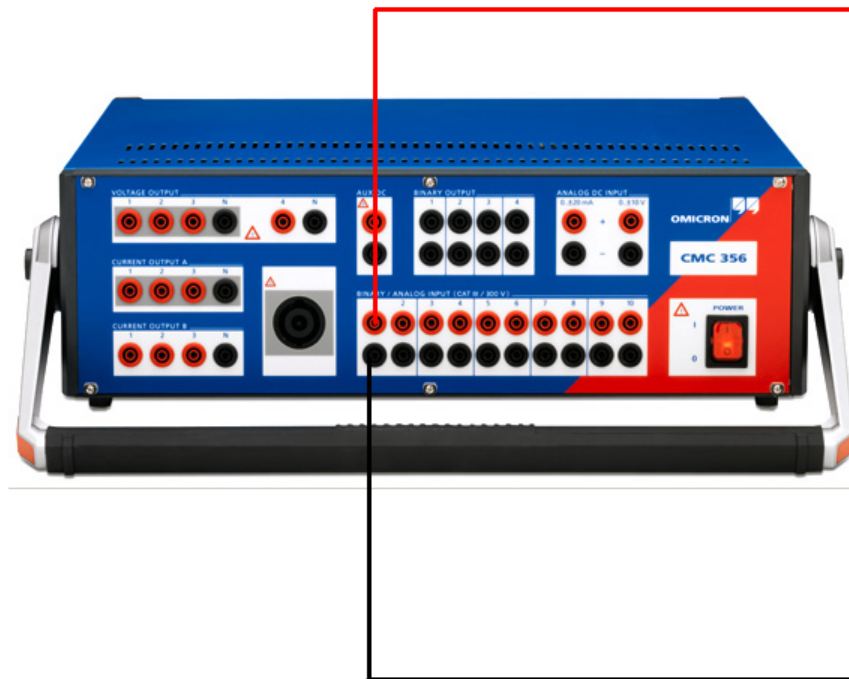


Figure 25: Binary output module (BOM). Output contacts named XA corresponds to rear position X31, X41 etc. and output contacts named XB to rear position X32, X42, etc.

RET 670 - CT RATIO

Local Server\RET 670 LAB 24-03-10 - PCM 600

File Edit View Tools IED Window Help

Project Explorer

Plant Structure

- RET 670 LAB 24-03-10
 - Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Power system
 - Communication
 - Analog modules
 - AnalogInp
 - AnalogInp
 - Reference
 - 3PhaseAn
 - 3PhAnalog
 - I/O modules
 - HMI
 - Differential prote
 - Current protecti
 - Voltage protecti
 - Control
 - Monitoring
 - Metering
 - Setting group N1

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|-----------|------|-----|-----------------|
| NAMECH1 | | TRM40-CH1 | | | 13 character(s) |
| RatedTrans1 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint1 | | ToObject | | | |
| CTsec1 | | 1 | A | 1 | 10 |
| CTprim1 | | 800 | A | 1 | 99999 |
| NAMECH2 | | TRM40-CH2 | | | 13 character(s) |
| RatedTrans2 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint2 | | ToObject | | | |
| CTsec2 | | 1 | A | 1 | 10 |
| CTprim2 | | 800 | A | 1 | 99999 |
| NAMECH3 | | TRM40-CH3 | | | 13 character(s) |
| RatedTrans3 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint3 | | ToObject | | | |
| CTsec3 | | 1 | A | 1 | 10 |
| CTprim3 | | 800 | A | 1 | 99999 |
| NAMECH4 | | TRM40-CH4 | | | 13 character(s) |
| RatedTrans4 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint4 | | ToObject | | | |
| CTsec4 | | 1 | A | 1 | 10 |
| CTprim4 | | 2500 | A | 1 | 99999 |
| NAMECH5 | | TRM40-CH5 | | | 13 character(s) |
| RatedTrans5 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint5 | | ToObject | | | |
| CTsec5 | | 1 | A | 1 | 10 |

Output

Logging

Wednesday, March 31, 2010 6:11:56 PM **ABB**

RET 670 - CT RATIO

Local Server\RET 670 MODIFIED 7-4-10 - PCM 600

File Edit View Tools IED Window Help

Object Types

Plant Structure

- Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Power system
 - Communication
 - Analog modules
 - AnalogInputs9land3U 1
 - AnalogInputs9land3U 2
 - Reference channel service values
 - 3PhaseAnalogGroup
 - 3PhAnalogSummationGroup
 - I/O modules
 - HMI
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1
 - Current protection
 - Voltage protection
 - Control
 - Monitoring
 - Metering
 - Setting group N1
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1
 - LowImpREF(PDIF,87N)
 - HighImpDifferential(PDIF,87)

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|-----------|------|-----|-----------------|
| NAMECH3 | | TRM40-CH3 | | | 13 character(s) |
| RatedTrans3 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint3 | | ToObject | | | |
| CTsec3 | | 1 | A | 1 | 10 |
| CTprim3 | | 800 | A | 1 | 99999 |
| NAMECH4 | | TRM40-CH4 | | | 13 character(s) |
| RatedTrans4 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint4 | | ToObject | | | |
| CTsec4 | | 1 | A | 1 | 10 |
| CTprim4 | | 2500 | A | 1 | 99999 |
| NAMECH5 | | TRM40-CH5 | | | 13 character(s) |
| RatedTrans5 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint5 | | ToObject | | | |
| CTsec5 | | 1 | A | 1 | 10 |
| CTprim5 | | 2500 | A | 1 | 99999 |
| NAMECH6 | | TRM40-CH6 | | | 13 character(s) |
| RatedTrans6 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint6 | | ToObject | | | |
| CTsec6 | | 1 | A | 1 | 10 |
| CTprim6 | | 2500 | A | 1 | 99999 |
| NAMECH7 | | TRM40-CH7 | | | 13 character(s) |
| RatedTrans7 | | 1.0 | A | 0.1 | 300.0 |

Object Properties

Output

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Logging

Relay parameter settings

The screenshot displays the RET 670 IEC software interface. On the left, the 'Plant Structure' tree shows a hierarchy from Region to Substation, Voltage Level, Bay, and RET 670 IEC. Under RET 670 IEC, there are folders for Settings, Time, General settings, Power system, Communication, Analog modules, I/O modules, HMI, Differential protection, Current protection, Voltage protection, Control, Monitoring, Metering, Setting group N1, and Differential protection. The 'T3D1' object is selected under the 'Differential protection' folder.

The main window shows the 'RET 670 IEC - Parameter...' table. The table has columns for Group / Parameter Name, IED Value, PC Value, Unit, Min, and Max. The parameters listed are:

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------------|------|------|---------|
| T3D1 | | | | | |
| RatedVoltageW1 | | 220.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW2 | | 110.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW3 | | 10.50 | kV | 0.05 | 2000.00 |
| RatedCurrentW1 | | 250 | A | 1 | 99999 |
| RatedCurrentW2 | | 500 | A | 1 | 99999 |
| RatedCurrentW3 | | 5240 | A | 1 | 99999 |
| ConnectTypeW1 | | WYE (Y) | | | |
| ConnectTypeW2 | | Delta (D) | | | |
| ConnectTypeW3 | | WYE (Y) | | | |
| ClockNumberW2 | | 1 [30 deg lag] | | | |
| ClockNumberW3 | | 0 [0 deg] | | | |
| ZSCurrSubtrW1 | | On | | | |
| ZSCurrSubtrW2 | | Off | | | |
| ZSCurrSubtrW3 | | On | | | |
| TconfigForW1 | | No | | | |
| CT1RatingW1 | | 400 | A | 1 | 99999 |
| CT2RatingW1 | | 3000 | A | 1 | 99999 |
| TconfigForW2 | | Yes | | | |
| CT1RatingW2 | | 2500 | A | 1 | 99999 |
| CT2RatingW2 | | 400 | A | 1 | 99999 |

The Output window at the bottom shows the following messages:

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Relay parameter settings

Local Server\RET 670 MODIFIED 7-4-10 - PCM 600

File Edit View Tools IED Window Help

Project Explorer

Plant Structure

- Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Power system
 - Communication
 - Analog modules
 - AnalogInputs3land3U 1
 - AnalogInputs3land3U 2
 - Reference channel service values
 - 3PhaseAnalogGroup
 - 3PhAnalogSummationGroup
 - I/O modules
 - HMI
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T301
 - Current protection
 - Voltage protection
 - Control
 - Monitoring
 - Metering
 - Setting group N1
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T301

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PCValue | Unit | Min | Max |
|------------------------|-----------|----------------|------|------|---------|
| T301 | | | | | |
| RatedVoltageW1 | | 220.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW2 | | 110.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW3 | | 10.50 | kV | 0.05 | 2000.00 |
| RatedCurrentW1 | | 250 | A | 1 | 99999 |
| RatedCurrentW2 | | 500 | A | 1 | 99999 |
| RatedCurrentW3 | | 5240 | A | 1 | 99999 |
| ConnectTypeW1 | | WYE (Y) | | | |
| ConnectTypeW2 | | Delta (D) | | | |
| ConnectTypeW3 | | WYE (Y) | | | |
| ClockNumberW2 | | 1 [30 deg lag] | | | |
| ClockNumberW3 | | 0 [0 deg] | | | |
| ZSCurrSubtW1 | | On | | | |
| ZSCurrSubtW2 | | Off | | | |
| ZSCurrSubtW3 | | On | | | |
| TconfigForW1 | | No | | | |
| CT1RatingW1 | | 400 | A | 1 | 99999 |
| CT2RatingW1 | | 3000 | A | 1 | 99999 |
| TconfigForW2 | | Yes | | | |
| CT1RatingW2 | | 2500 | A | 1 | 99999 |
| CT2RatingW2 | | 400 | A | 1 | 99999 |

Object Properties

Output

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Logging

Handwritten calculations and annotations:

- $I = \text{MVA} / 1.732 * 220000$
- $= 249.97 \sim 250A$
- $I = \text{MVA} / 1.732 * 110000$
- $= 499.94 \sim 500A$

Relay parameter settings

The screenshot shows the RET 670 IEC - Parameter ... window. The left pane displays the Plant Structure tree, and the right pane displays the Parameter table.

Plant Structure:

- Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Power system
 - Communication
 - Analog modules
 - AnalogInputs9Iand3U 1
 - AnalogInputs9Iand3U 2
 - Reference channel service values
 - 3PhaseAnalogGroup
 - 3PhAnalogSummationGroup
 - I/O modules
 - HMI
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1
 - Current protection
 - Voltage protection
 - Control
 - Monitoring
 - Metering
 - Setting group N1
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1

Parameter Table:

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------|------|------|-------|
| CT1RatingW1 | | 400 | A | 1 | 99999 |
| CT2RatingW1 | | 3000 | A | 1 | 99999 |
| TconfigForW2 | | Yes | | | |
| CT1RatingW2 | | 2500 | A | 1 | 99999 |
| CT2RatingW2 | | 400 | A | 1 | 99999 |
| TconfigForW3 | | No | | | |
| CT1RatingW3 | | 3000 | A | 1 | 99999 |
| CT2RatingW3 | | 3000 | A | 1 | 99999 |
| LocationOLTC1 | | Not Used | | | |
| LowTapPosOLTC1 | | 1 | | 0 | 10 |
| RatedTapOLTC1 | | 6 | | 1 | 100 |
| HighTapPsOLTC1 | | 11 | | 1 | 100 |
| TapHighVoltTC1 | | 1 | | 1 | 100 |
| StepSizeOLTC1 | | 1.00 | % | 0.01 | 30.00 |
| LocationOLTC2 | | Not Used | | | |
| LowTapPosOLTC2 | | 1 | | 0 | 10 |
| RatedTapOLTC2 | | 6 | | 1 | 100 |
| HighTapPsOLTC2 | | 11 | | 1 | 100 |
| TapHighVoltTC2 | | 1 | | 1 | 100 |
| StepSizeOLTC2 | | 1.00 | % | 0.01 | 30.00 |

Output:

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Logging



Antony RAJA, INOPC - 08/08/2013

RET 670

**Differential slope setting in
omicron**

Differential Slope Setting

**OMICRON**

TEST UNIVERSE V2.30

Get Support | Customer Area

www.omicron.at | www.omicronusa.com

Test Modules

Stand-alone Startup

- QuickCMC Ramping...
- State Sequencer
- Advanced TransPlay
- Overcurrent Distance...
- Autoreclosure
- Differential...
- Synchronizer
- Annunciation Checker
- Network Simulation...
- Meter
- Transducer
- PQ Signal Generator
- IEC 61850...
- CB Configuration

Control Center

Create Multifunctional Test Documents

- Open Existing Test Document
- Open Protection Testing Library
- Open Generic Template
- New Test Document

Test Administration

Relay and Test Database

- TestBase
 - Diff Configuration
 - Diff Operating Characteristic
 - Diff Trip Time Characteristic
 - Diff Harmonic Restraint
- TestBase
- EnerLyzer
- TransView
- Harmonics
- Binary I/O Monitor
- Polarity Checker
- O/C Characteristics Grabber
- Scheme Testing Tools...
- AuxDC

Setup

Prepare Test Equipment

- Test Set Association
- System Settings
- License Manager
- Language Selection

Support

Documentation and Assistance

- Tutorials
- Manuals
- Help
- Tips & Tricks
- Contacts
- OMICRON Assist
- Diagnosis & Calibration...
- What's New

Custom

User-specific Tools

Differential Slope Setting

OMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window Help

Hardware Configuration

General Analog Outputs Binary / Analog Inputs Binary Outputs IRIG-B & GPS

Test Points

Idiff Ibias ta

Idiff 0.00 In

Ibias 0.00 In

Fault type

☒ L1-E ☐ L1-L2

☐ L2-E ☐ L2-L3

☐ L3-E ☐ L3-L1

Result

Act.

| Test Module | Output Signal | Display Name | Connection Terminal | CMC356 V A | | | | CMC356 V B | | CMC356 I A | | | | CMC356 I B | | | |
|-------------|---------------|--------------|---------------------|------------|---|---|----|------------|----|------------|---|---|----|------------|---|---|----|
| | | | | 1 | 2 | 3 | II | 1 | II | 1 | 2 | 3 | II | 1 | 2 | 3 | II |
| Not used | V L1-E | | | X | | | | | | | | | | | | | |
| Not used | V L2-E | | | | X | | | | | | | | | | | | |
| Not used | V L3-E | | | | | X | | | | | | | | | | | |
| Not used | V(2)-1 | | | | | | | X | | | | | | | | | |
| I Prim L1 | I Prim L1 | | | | | | | | X | | | | | | | | |
| I Prim L2 | I Prim L2 | | | | | | | | | X | | | | | | | |
| I Prim L3 | I Prim L3 | | | | | | | | | | X | | | | | | |
| I Sec L1 | I Sec L1 | | | | | | | | | | | X | | | | | |
| I Sec L2 | I Sec L2 | | | | | | | | | | | | X | | | | |
| I Sec L3 | I Sec L3 | | | | | | | | | | | | | X | | | |

Select Apply & OK after doing the analog output selection

OK Cancel Apply Help

(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.

Differential Slope Setting

OMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window Help

Shot Test Search Test General **Test Object Parameters** Binary

Test Points

| Idiff | Ibias | tact | tnom |
|-------|-------|------|------|
|-------|-------|------|------|

Select the Test object parameters tool

Idiff: 0.00 In Add

Ibias: 0.00 In Remove Remove All

Fault type

☒ L1-E ☐ L1-L2 ☐ L1-L2-L3

☐ L2-E ☐ L2-L3

☐ L3-E ☐ L3-L1

Result

Act. Dev.

Operating Characteristic Diagram

Idiff [In]

Ibias [In]

1 2 3 4 5 6 7 8 9

0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25

1 2 3 4 5 6 7 8 9 10

(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.

Test object and protected object parameters property sheet.

Differential Slope Setting

The screenshot displays the 'OMICRON Diff Operating Characteristic' software window. The 'Test Object' dialog box is open, showing a tree view on the left with 'Device' selected. A red arrow points to 'Device' with the text 'Select Device & then select Edit'. Another red arrow points to the 'Edit...' button with the text 'select Edit'. The dialog box has tabs for 'Test Points', 'General', and 'BI'. The 'Test Points' tab is active, showing 'Idiff' and 'Ibias' settings both at '0.00 In'. The 'Fault type' section has radio buttons for 'L1-E', 'L2-E', 'L3-E', 'L1-L2', 'L2-L3', and 'L3-L1'. The 'Result' section has 'Act.' and 'Dev.' fields. The 'DEVICE' section contains the text 'Press Edit to view or edit this test object settings.' and an 'Edit...' button. The bottom of the dialog box shows 'I: 0 W: 0 E: 0' with a green checkmark, and 'OK' and 'Cancel' buttons. A graph at the bottom shows 'Ibias [In]' on the x-axis (0 to 9) and a y-axis with values 0.00 and 0.25. A red dashed line is plotted. The status bar at the bottom left shows '(ENG020) No CMC is connected to PC.' and 'For Help, press F1'. The bottom right shows a row of 10 status indicators.

OMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window Help

Shot Test Search Test General BI

Test Object

File View Function Help

Test Points

Idiff Ibias

Idiff 0.00 In

Ibias 0.00 In

Fault type

☒ L1-E ☐ L1-L2

☐ L2-E ☐ L2-L3

☐ L3-E ☐ L3-L1

Result

Act. Dev.

Custom

RIO

Device

Differential

CB Configuration

DEVICE

Press Edit to view or edit this test object settings.

Edit...

I: 0 W: 0 E: 0

OK Cancel

0.25

0.00

Ibias [In]

1 2 3 4 5 6 7 8 9 10

(ENG020) No CMC is connected to PC.

(ENG020) No CMC is connected to PC.

(ENG020) No CMC is connected to PC.

For Help, press F1

Differential Slope Setting

DMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window

Shot Test Search Test General Bi Test Ob

Test Points

Idiff Ibias

Idiff 0.00 In

Ibias 0.00 In

Fault type

☒ L1-E ☐ L1-L2 ☐ L2-E ☐ L2-L3 ☐ L3-E ☐ L3-L1

Result

Act. Dev.

Device Settings

Device Settings

Device

Name/description: RET 670

Manufacturer: ABB

Device type: DIFFERENTIAL PROTECTION

Device address: BAY1

Serial/model number: TO9878789

Additional information 1: 3 WINDING DIFF RELAY

Additional information 2:

Nominal Values

Number of phases: ☐ 2 ☒ 3

f nom: 50.000 Hz

V nom (secondary): 110.000 kV (L-L)
63.508 kV (L-N)

V primary: 220.000 kV (L-L)
127.017 kV (L-N)

I nom (secondary): 1.000 A

I primary: 800.000 A

Substation

Name: BALOOK

Address: MACKAY

Bay

Name: FEEDER 01

Address: MACKAY

Overload Detection Sensitivity

☒ High ☐ Custom 50.000 ms ☐ Low ☐ Off

Residual Voltage/Current Factors

VLN/ VN: 1.732

IN / I nom: 1.000

Limits

V max: 200.000 V (L-L)

I max: 50.000 A

Debounce/Deglitch Filters

Debounce time: 3.000 ms

Deglitch time: 0.000 s

OK Cancel Help

Cancel

Ibias [In]

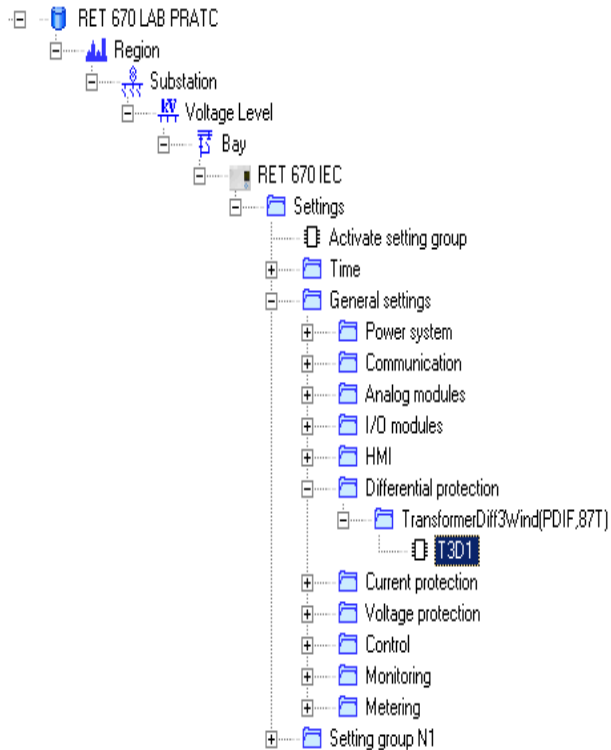
1 2 3 4 5 6 7 8 9

(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.

1 2 3 4 5 6 7 8 9 10

For Help, press F1

Differential Slope Setting



| RET 670 IEC - Parameter ... | | |
|-----------------------------|-----------|----------------|
| Group / Parameter Name | IED Value | PC Value |
| T3D1 | | |
| RatedVoltageW1 | | 220.00 |
| RatedVoltageW2 | | 110.00 |
| RatedVoltageW3 | | 10.50 |
| RatedCurrentW1 | | 250 |
| RatedCurrentW2 | | 500 |
| RatedCurrentW3 | | 5240 |
| ConnectTypeW1 | | WYE (Y) |
| ConnectTypeW2 | | Delta (D) |
| ConnectTypeW3 | | WYE (Y) |
| ClockNumberW2 | | 0 [0 deg] |
| ClockNumberW3 | | 1 [30 deg lag] |
| ZSCurrSubtrW1 | | On |
| ZSCurrSubtrW2 | | Off |
| ZSCurrSubtrW3 | | On |
| TconfigForW1 | | No |
| CT1RatingW1 | | 800 |
| CT2RatingW1 | | 800 |
| TconfigForW2 | | No |
| CT1RatingW2 | | 2500 |
| CT2RatingW2 | | 2500 |

Device Settings

Device

Name/description: RET 670
Manufacturer: ABB
Device type: DIFFERENTIAL PROTECTION
Device address: BAY1
Serial/model number: T09878789
Additional information 1: 3 WINDING DIFF RELAY
Additional information 2:

Nominal Values

Number of phases: 2 3
f nom: 50.000 Hz
V nom (secondary): 110.000 kV (L-L) 63.508 kV (L-N)
V primary: 220.000 kV (L-L) 127.017 kV (L-N)
I nom (secondary): 1.000 A
I primary: 800.000 A

Substation

Name: BALOOK
Address: MACKAY

Bay

Name: FEEDER 01
Address: MACKAY

Overload Detection Sensitivity

☒ High ☐ Custom 50.000 ms ☐ Low ☐ Off

Residual Voltage/Current Factors

VLN/ VN: 1.732
IN / I nom: 1.000

Limits

V max: 200.000 V (L-L)
I max: 50.000 A

Debounce/Degitch Filters

Debounce time: 3.000 ms
Deglitch time: 0.000 s

OK

Cancel

Help

Differential Slope Setting

DMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window Help

Shot Test Search Test General Bi

Test Object

File View Function Help

Test Points

Idiff Ibias

Custom
RIO
Device
Differential
UB Configuration

DIFFERENTIAL

Press Edit to view or edit this test object settings.

Edit...

Select Differential
& then select Edit

Idiff 0.00 In

Ibias 0.00 In

Fault type

☒ L1-E ☐ L1-L2
☐ L2-E ☐ L2-L3
☐ L3-E ☐ L3-L1

Result

Act. Dev.

I: 0 W: 0 E: 0

OK Cancel

0.25

0.00

1 2 3 4 5 6 7 8 9

Ibias [In]

(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.

1 2 3 4 5 6 7 8 9 10

For Help, press F1

The screenshot shows the 'DMICRON Diff Operating Characteristic' software. The 'Test Object' window is the central focus, displaying a tree view on the left with 'Differential' highlighted. A red arrow points from the text 'Select Differential' to this item. Another red arrow points from '& then select Edit' to the 'Edit...' button. The main pane of the 'Test Object' window shows the title 'DIFFERENTIAL' and the instruction 'Press Edit to view or edit this test object settings.' Below the window, a graph plots 'Idiff' (y-axis, 0.00 to 0.25) against 'Ibias [In]' (x-axis, 1 to 9). The status bar at the bottom contains three error messages: '(ENG020) No CMC is connected to PC.' and a help prompt 'For Help, press F1'.

Differential Slope Setting

The screenshot displays the 'Differential Protection Parameters' dialog box in the OMICRON Diff Operating Characteristic software. The 'Protected Object' is set to 'Transformer', and the 'Vector Group' is 'YD1Y0'. The 'Number of Windings' is set to 3. The 'Nominal Values' section includes fields for Winding/Leg Name, Voltage, Power, Vector Group, Starpoint Grounding, Current, and Delta-Connected CT. The 'Fault type' section shows radio buttons for L1-E, L2-E, L3-E, L1-L2, L2-L3, and L3-L1. The 'Result' section has 'Act.' and 'Dev.' fields. The background shows a test point diagram with a transformer and a fault location on a line.

Relay parameter settings

The screenshot displays the RET 670 IEC software interface. On the left, the 'Plant Structure' tree shows the hierarchy: Region > Substation > Voltage Level > Bay > RET 670 IEC > Settings > T3D1. The main window shows the 'RET 670 IEC - Parameter' table for the T3D1 object. The table has columns for Group / Parameter Name, IED Value, PC Value, Unit, Min, and Max. A yellow box highlights the parameters RatedVoltageW1, RatedVoltageW2, RatedVoltageW3, RatedCurrentW1, RatedCurrentW2, RatedCurrentW3, and ZSCurrSubtrW1. The Output window at the bottom shows two messages: 'Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC' and 'Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10'.

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------------|------|------|---------|
| T3D1 | | | | | |
| RatedVoltageW1 | | 220.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW2 | | 110.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW3 | | 10.50 | kV | 0.05 | 2000.00 |
| RatedCurrentW1 | | 250 | A | 1 | 99999 |
| RatedCurrentW2 | | 500 | A | 1 | 99999 |
| RatedCurrentW3 | | 5240 | A | 1 | 99999 |
| ConnectTypeW1 | | WYE (Y) | | | |
| ConnectTypeW2 | | Delta (D) | | | |
| ConnectTypeW3 | | WYE (Y) | | | |
| ClockNumberW2 | | 1 [30 deg lag] | | | |
| ClockNumberW3 | | 0 [0 deg] | | | |
| ZSCurrSubtrW1 | | On | | | |
| ZSCurrSubtrW2 | | Off | | | |
| ZSCurrSubtrW3 | | On | | | |
| TconfigForW1 | | No | | | |
| CT1RatingW1 | | 400 | A | 1 | 99999 |
| CT2RatingW1 | | 3000 | A | 1 | 99999 |
| TconfigForW2 | | Yes | | | |
| CT1RatingW2 | | 2500 | A | 1 | 99999 |
| CT2RatingW2 | | 400 | A | 1 | 99999 |

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Differential Slope Setting

Differential Protection Parameters

Protected Object: CT Protection Device Characteristic Definition Harmonic

Protected Object: Transformer

Vector Group: YD1Y0

Number of Windings: ☐ 2 ☒ 3

Nominal Values

| | Primary | Secondary | Tertiary |
|----------------------|-----------|-----------|-----------|
| Winding/Leg Name: | Primary | Secondary | Tertiary |
| Voltage: | 220.00 kV | 110.00 kV | 10.50 kV |
| Power: | 95.25 MVA | 95.25 MVA | 95.25 MVA |
| Vector Group: | Y | D1 (D30°) | Y0 (Y0°) |
| Starpoint Grounding: | Yes | No | Yes |
| Current: | 249.97 A | 499.93 A | 5.24 kA |
| Delta-Connected CT: | No | No | |

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------------|------|------|--------|
| T3D1 | | | | | |
| RatedVoltageW1 | | 220.00 | kV | 0.05 | 2000.0 |
| RatedVoltageW2 | | 110.00 | kV | 0.05 | 2000.0 |
| RatedVoltageW3 | | 10.50 | kV | 0.05 | 2000.0 |
| RatedCurrentW1 | | 250 | A | 1 | 99999 |
| RatedCurrentW2 | | 500 | A | 1 | 99999 |
| RatedCurrentW3 | | 5240 | A | 1 | 99999 |
| ConnectTypeW1 | | WYE (Y) | | | |
| ConnectTypeW2 | | Delta (D) | | | |
| ConnectTypeW3 | | WYE (Y) | | | |
| ClockNumberW2 | | 1 [30 deg lag] | | | |
| ClockNumberW3 | | 0 [0 deg] | | | |
| ZSCurrSubtW1 | | On | | | |
| ZSCurrSubtW2 | | Off | | | |
| ZSCurrSubtW3 | | On | | | |
| TconfigForW1 | | No | | | |
| CT1RatingW1 | | 400 | A | 1 | 99999 |
| CT2RatingW1 | | 3000 | A | 1 | 99999 |
| TconfigForW2 | | Yes | | | |
| CT1RatingW2 | | 2500 | A | 1 | 99999 |
| CT2RatingW2 | | 400 | A | 1 | 99999 |

Differential Slope Testing

DMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window Help

Test Points

Idiff Ibias

Idiff 0.00 In

Ibias 0.00 In

Fault type

☒ L1-E ☐ L1-L2

☐ L2-E ☐ L2-L3

☐ L3-E ☐ L3-L1

Result

Act. Dev.

Differential Protection Parameters

Protected Object **CT** Protection Device Characteristic Definition Harmonic

CT Nominal Values

| | Primary | Secondary | Tertiary |
|----------------------|-----------------|-----------------|-----------------|
| Primary Current: | 800.00 A | 2.50 kA | 3.00 kA |
| Secondary Current: | 1.00 A | 1.00 A | 1.00 A |
| Starpoint Grounding: | tow. Prot. Obj. | tow. Prot. Obj. | tow. Prot. Obj. |

☐ Use Ground Current Measurement inputs (CT)

Ground CT Nominal Values

| | Primary | Secondary | Tertiary |
|----------------------|-----------------|-----------------|-----------------|
| Primary Current: | 200.00 A | 800.00 A | 800.00 A |
| Secondary Current: | 1.00 A | 1.00 A | 1.00 A |
| Starpoint Grounding: | tow. Prot. Obj. | tow. Prot. Obj. | tow. Prot. Obj. |

OK Cancel Help

0.00 1 2 3 4 5 6 7 8 9

Ibias [In]

(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.

1 2 3 4 5 6 7 8 9 10

For Help, press F1

RET 670 - CT RATIO

Local Server\RET 670 LAB 24-03-10 - PCM 600

File Edit View Tools IED Window Help

Project Explorer

Plant Structure

- RET 670 LAB 24-03-10
 - Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Power system
 - Communication
 - Analog modules
 - AnalogInp1
 - AnalogInp2
 - Reference
 - 3PhaseAn
 - 3PhAnalog
 - I/O modules
 - HMI
 - Differential prote
 - Current protecti
 - Voltage protecti
 - Control
 - Monitoring
 - Metering
 - Setting group N1

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|-----------|------|-----|-----------------|
| NAMECH1 | | TRM40-CH1 | | | 13 character(s) |
| RatedTrans1 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint1 | | ToObject | | | |
| CTsec1 | 1 | | A | 1 | 10 |
| CTprim1 | 800 | | A | 1 | 99999 |
| NAMECH2 | | TRM40-CH2 | | | 13 character(s) |
| RatedTrans2 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint2 | | ToObject | | | |
| CTsec2 | 1 | | A | 1 | 10 |
| CTprim2 | 800 | | A | 1 | 99999 |
| NAMECH3 | | TRM40-CH3 | | | 13 character(s) |
| RatedTrans3 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint3 | | ToObject | | | |
| CTsec3 | 1 | | A | 1 | 10 |
| CTprim3 | 800 | | A | 1 | 99999 |
| NAMECH4 | | TRM40-CH4 | | | 13 character(s) |
| RatedTrans4 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint4 | | ToObject | | | |
| CTsec4 | 1 | | A | 1 | 10 |
| CTprim4 | 2500 | | A | 1 | 99999 |
| NAMECH5 | | TRM40-CH5 | | | 13 character(s) |
| RatedTrans5 | | 1.0 | A | 0.1 | 300.0 |
| CTStarPoint5 | | ToObject | | | |
| CTsec5 | 1 | | A | 1 | 10 |

Output

Logging

Wednesday, March 31, 2010 6:11:56 PM

ABB

Differential Slope Setting

DMICRON Diff Operating Characteristic - [Test View: DiffOpChar1]

File Edit View Test Parameters Window Help

Differential Protection Parameters

Protected Object CT **Protection Device** Characteristic Definition Harmonic

Ibias Calculation
max (Ip, Is)
Factor K1 = 1.00
☒ No combined characteristic

Reference Winding
Primary

Reference Current
☒ Protected Object Nominal Current
☐ Current Transformer Nominal Current

Test Time Settings / Transformer Model
Test Max: 1.500 s
Delay Time: 0.250 s

Zero Sequence Elimination
☒ IL - IO ☐ none
☐ YD interposing transformer
☐ YDY interposing transformer

Diff Current Settings
Idiff> 0.30 In
Idiff>> 10.00 In

Diff Time Settings
tdiff> 0.030 s
tdiff>> 0.030 s

Current Tolerances
relative: 2.00 %
absolute: 0.05 In

Time Tolerances
relative: 3.00 %
absolute: 0.010 s

OK Cancel Help

Shot Test Search Test General Bi

Test Points
Idiff Ibias

Idiff 0.00 In
Ibias 0.00 In

Fault type
☒ L1-E ☐ L1-L2
☐ L2-E ☐ L2-L3
☐ L3-E ☐ L3-L1

Result
Act. Dev.

0.00 1 2 3 4 5 6 7 8 9

Ibias [In]

(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.
(ENG020) No CMC is connected to PC.

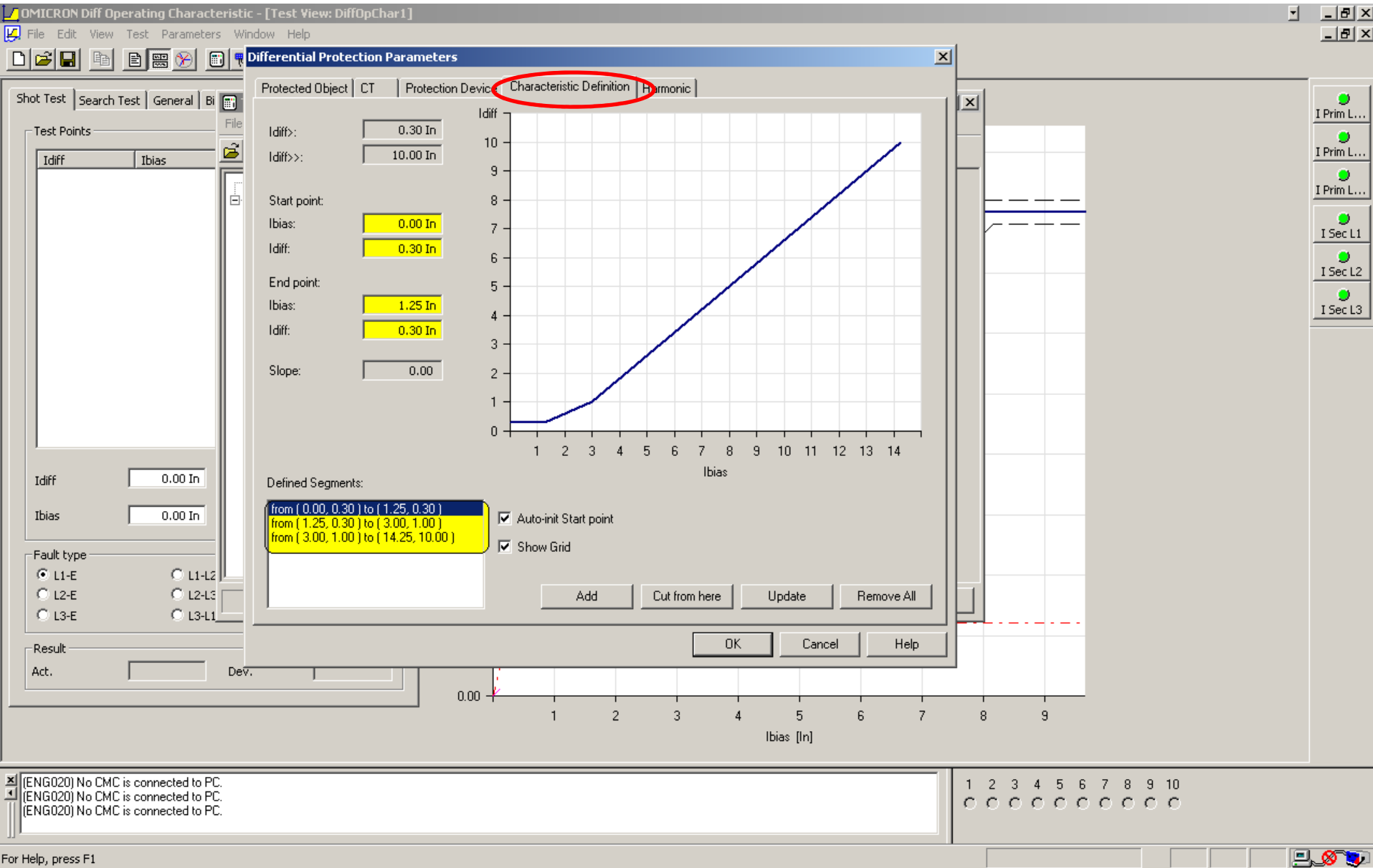
1 2 3 4 5 6 7 8 9 10
C C C C C C C C C C

For Help, press F1

Relay parameter settings

[illegible]

Differential Slope Setting





Antony RAJA, INOPC - 08/08/2013

RET 670

Differential Slope Plotting

Differential Slope Plotting

The screenshot displays the RET 670 IEC software interface. On the left, the 'Plant Structure' tree shows the hierarchy: Region > Substation > Voltage Level > Bay > RET 670 IEC > Settings > General settings > I/O modules > T3D1. The main window on the right shows the 'RET 670 IEC - Parameter' table. The table has columns: Group / Parameter Name, IED Value, PC Value, Unit, Min, and Max. The 'RatedCurrentW2' parameter is highlighted with a red oval and labeled 'IBias'.

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------------|------|------|---------|
| T3D1 | | | | | |
| RatedVoltageW1 | | 220.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW2 | | 110.00 | kV | 0.05 | 2000.00 |
| RatedVoltageW3 | | 10.50 | kV | 0.05 | 2000.00 |
| RatedCurrentW1 | | 250 | A | 1 | 99999 |
| RatedCurrentW2 | | 500 | A | 1 | 99999 |
| RatedCurrentW3 | | 5240 | A | 1 | 99999 |
| ConnectTypeW1 | | WYE (Y) | | | |
| ConnectTypeW2 | | Delta (D) | | | |
| ConnectTypeW3 | | WYE (Y) | | | |
| ClockNumberW2 | | 1 [30 deg lag] | | | |
| ClockNumberW3 | | 0 [0 deg] | | | |
| ZSCurrSubtrW1 | | On | | | |
| ZSCurrSubtrW2 | | Off | | | |
| ZSCurrSubtrW3 | | On | | | |
| TconfigForW1 | | No | | | |
| CT1RatingW1 | | 400 | A | 1 | 99999 |
| CT2RatingW1 | | 3000 | A | 1 | 99999 |
| TconfigForW2 | | Yes | | | |
| CT1RatingW2 | | 2500 | A | 1 | 99999 |
| CT2RatingW2 | | 400 | A | 1 | 99999 |

The 'Output' window at the bottom shows the following log entries:

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|--------|---|
| 5/4/2010 10:35:55.236 AM | Message | [local]\admin - Syste... | System | Project closed: IN-L-INAA009057\PCMSERVER\RET 670 LAB PRATC |
| 5/4/2010 10:35:55.471 AM | Message | [local]\admin - Syste... | System | Project opened: IN-L-INAA009057\PCMSERVER\RET 670 MODIFIED 7-4-10 |

Differential Slope Plotting

Local Server\RET 670 LAB PRATC - PCM 600

File Edit View Tools IED Window Help

Object Types

Project Explorer

Plant Structure

- RET 670 LAB PRATC
 - Region
 - Substation
 - Voltage Level
 - Bay
 - RET 670 IEC
 - Settings
 - Activate setting group
 - Time
 - General settings
 - Setting group N1
 - Differential protection
 - TransformerDiff3Wind(PDIF,87T)
 - T3D1
 - LowImpREF(PDIF,87N)
 - HighImpDifferential(PDIF,87)
 - Current protection
 - Voltage protection
 - Frequency protection
 - Secondary system supervision
 - Control
 - Logic

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------|------|-------|---------|
| T3D1 | | | | | |
| Operation | | On | | | |
| SOTFMode | | Off | | | |
| IDiffAlarm | | 0.20 | %IB | 0.05 | 1.00 |
| tAlarmDelay | | 10.000 | s | 0.000 | 60.000 |
| IdMin | | 0.30 | IB | 0.10 | 0.60 |
| EndSection1 | | 1.25 | IB | 0.20 | 1.50 |
| EndSection2 | | 3.00 | IB | 1.00 | 10.00 |
| SlopeSection2 | | 40.0 | % | 10.0 | 50.0 |
| SlopeSection3 | | 80.0 | % | 30.0 | 100.0 |
| IdUnre | | 10.00 | IB | 1.00 | 50.00 |
| I2/I1Ratio | | 15.0 | % | 5.0 | 100.0 |
| I5/I1Ratio | | 25.0 | % | 5.0 | 100.0 |
| CrossBlockEn | | On | | | |
| NegSeqDiffEn | | Off | | | |
| IMinNegSeq | | 0.04 | IB | 0.02 | 0.20 |
| NegSeqROA | | 60.0 | Deg | 30.0 | 120.0 |
| OpenCTEnable | | On | | | |
| tOCTAlarmDelay | | 3.000 | s | 0.100 | 10.000 |
| tOCTResetDelay | | 0.250 | s | 0.100 | 10.000 |
| tOCTUnrstDelay | | 10.00 | s | 0.10 | 6000.00 |

Required values for differential slope plotting

Output

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|-------------|---|
| 5/6/2010 10:01:11.866 AM | Warning | [local]\admin - Syste... | T670_I | No goose receive logical devices found. |
| 5/6/2010 10:01:12.616 AM | Warning | [local]\admin - Syste... | RET 670 IEC | No goose receive data configured! |

Logging

Thursday, May 06, 2010 2:30:32 PM

ABB

Differential Slope Plotting

Given Values :-

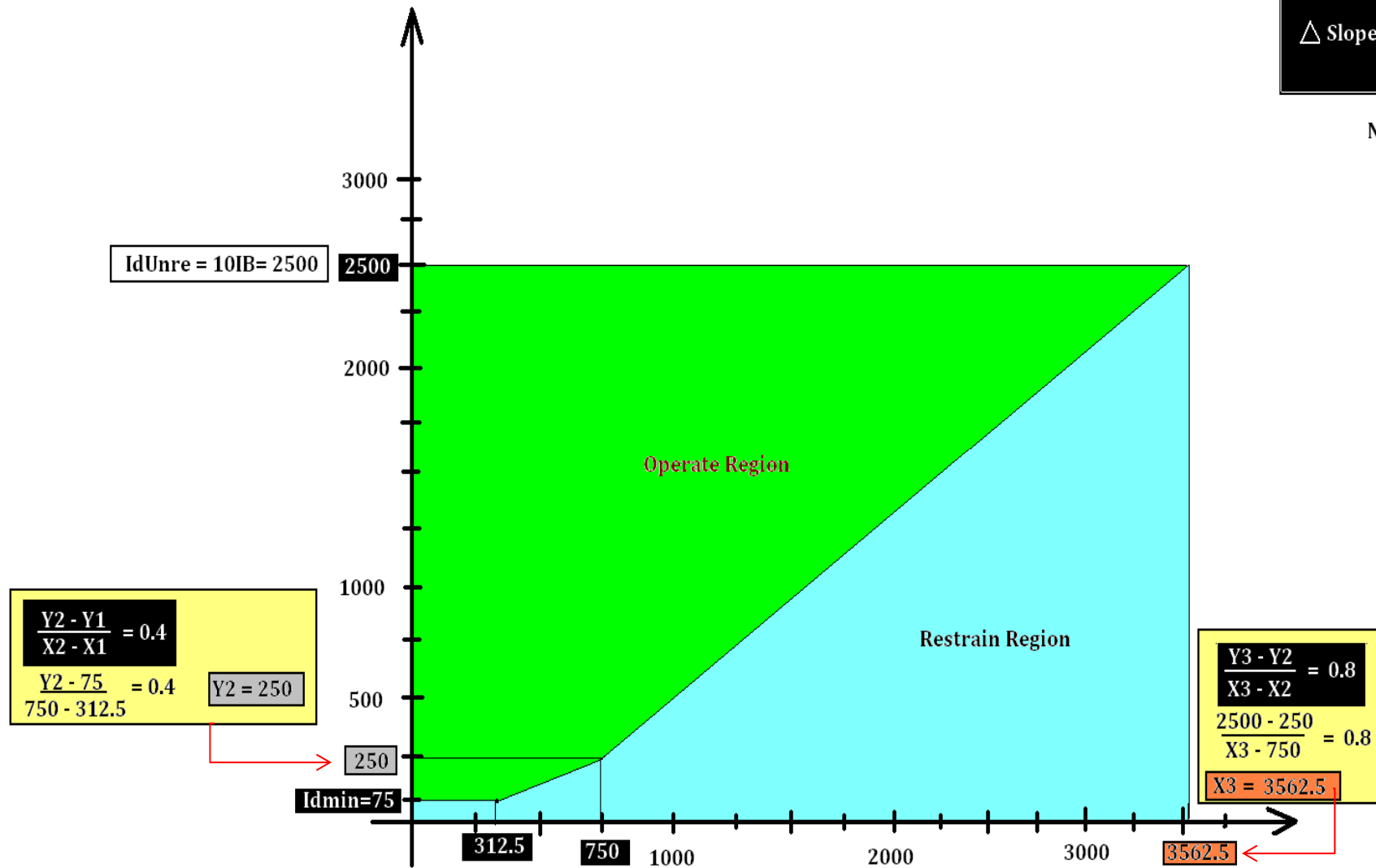
- | | | | | |
|----|---------------|---|--------------------|---------|
| 1) | Ibias | = | 250 | |
| 2) | Idmin | = | 0.3 IB | = 75 |
| 3) | Endsection 1 | = | 1.25 IB | = 312.5 |
| 4) | Endsection 2 | = | 3.00 IB | = 750 |
| 5) | Slopesection2 | = | 40% | |
| 6) | Slopesection3 | = | 80% | |
| 7) | IdUnre | = | 10 IB | = 2500 |
| 8) | X3 | = | ? Refer next slide | |
| 9) | Y2 | = | ? Refer next slide | |

Differential Slope Plotting Procedure

Formula

$$\Delta \text{ Slope} = \frac{\Delta I_{\text{diff}}}{\Delta I_{\text{bias}}}$$

Note :- $I_b = 250$



Differential Slope Plotting

Local Server\RET 670 LAB PRATC - PCM 600

File Edit View Tools IED Window Help

Object Types

Project Explorer

Plant Structure

- RET 670 LAB PRATC
 - Region
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 - Voltage Level
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 - RET 670 IEC
 - Settings
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 - Setting group N1
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 - T3D1
 - LowImpREF(PDIF,87N)
 - HighImpDifferential(PDIF,87)
 - Current protection
 - Voltage protection
 - Frequency protection
 - Secondary system supervision
 - Control
 - Logic

RET 670 IEC - Parameter ...

| Group / Parameter Name | IED Value | PC Value | Unit | Min | Max |
|------------------------|-----------|----------|------|-------|---------|
| T3D1 | | | | | |
| Operation | | On | | | |
| SOTFMode | | Off | | | |
| IDiffAlarm | | 0.20 | %IB | 0.05 | 1.00 |
| tAlarmDelay | | 10.000 | s | 0.000 | 60.000 |
| IdMin | | 0.30 | IB | 0.10 | 0.60 |
| EndSection1 | | 1.25 | IB | 0.20 | 1.50 |
| EndSection2 | | 3.00 | IB | 1.00 | 10.00 |
| SlopeSection2 | | 40.0 | % | 10.0 | 50.0 |
| SlopeSection3 | | 80.0 | % | 30.0 | 100.0 |
| IdUnre | | 10.00 | IB | 1.00 | 50.00 |
| I2/I1Ratio | | 15.0 | % | 5.0 | 100.0 |
| I5/I1Ratio | | 25.0 | % | 5.0 | 100.0 |
| CrossBlockEn | | On | | | |
| NegSeqDiffEn | | Off | | | |
| IMinNegSeq | | 0.04 | IB | 0.02 | 0.20 |
| NegSeqROA | | 60.0 | Deg | 30.0 | 120.0 |
| OpenCTEnable | | On | | | |
| tOCTAlarmDelay | | 3.000 | s | 0.100 | 10.000 |
| tOCTResetDelay | | 0.250 | s | 0.100 | 10.000 |
| tOCTUnrstDelay | | 10.00 | s | 0.10 | 6000.00 |

Output

| Date and Time | Category | User | Object | Message |
|--------------------------|----------|--------------------------|-------------|---|
| 5/6/2010 10:01:11.866 AM | Warning | [local]\admin - Syste... | T670_I | No goose receive logical devices found. |
| 5/6/2010 10:01:12.616 AM | Warning | [local]\admin - Syste... | RET 670 IEC | No goose receive data configured! |

Logging

Thursday, May 06, 2010 2:30:32 PM

ABB

Differential Slope Plotting Procedure

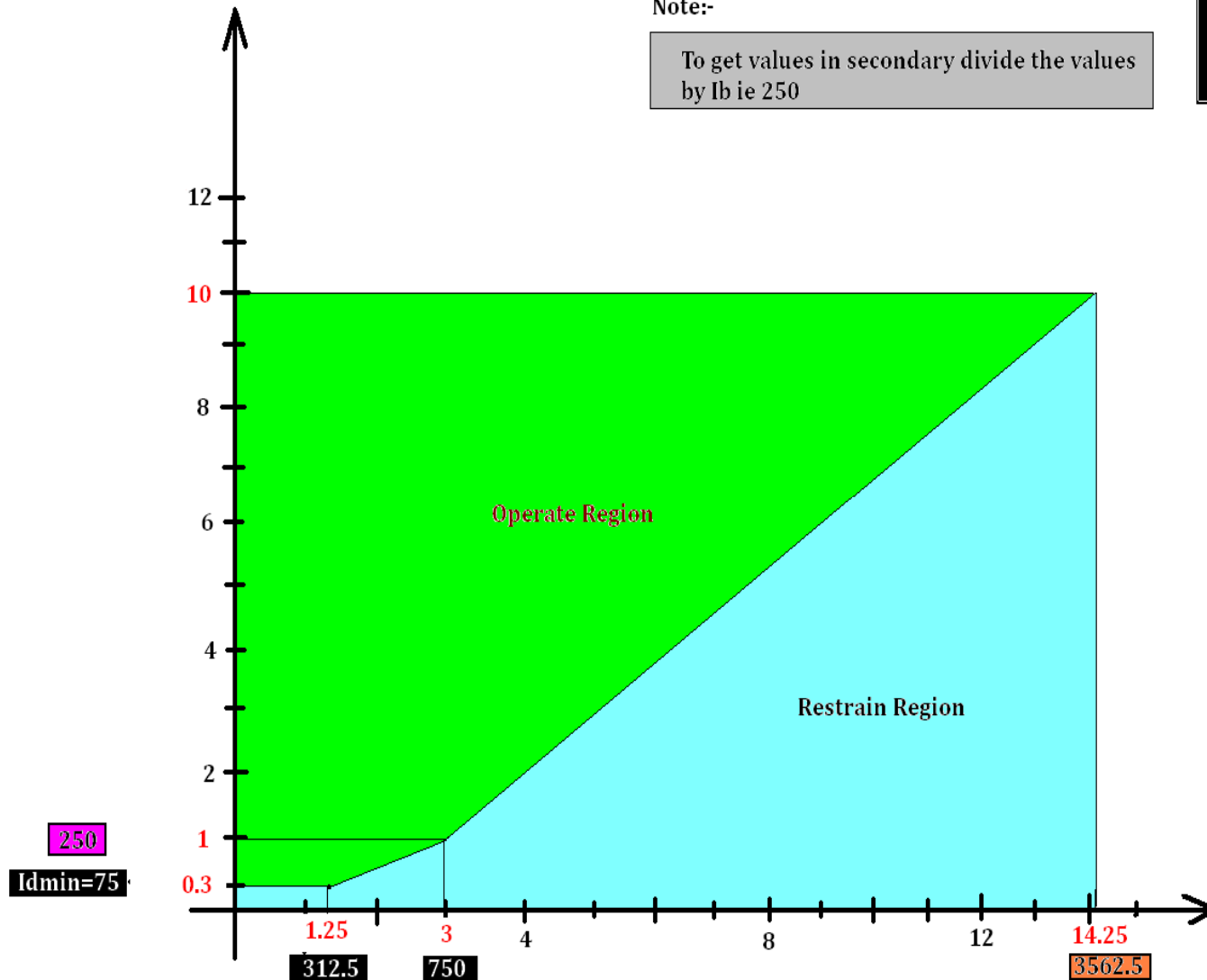
Note:-

To get values in secondary divide the values by Ib ie 250

Formula

$$\Delta \text{ Slope} = \frac{\Delta \text{ Idiff}}{\Delta \text{ Ibias}}$$

Note :- Ib = 250



Differential Slope Plotting

The image shows a software interface for configuring differential protection parameters. The main window is titled "Test Object" and has a menu bar with "File", "View", "Function", and "Help". On the left, there is a tree view with the following structure:

- Custom
 - RIO
 - Device
 - Differential
 - CB Configuration

The main area displays the word "DIFFERENTIAL" and the text "Press Edit to view or edit this test". Below this is an "Edit..." button. At the bottom of the main window, there is a status bar showing "t: 0 W: 0 E: 0" and a green checkmark.

Below the main window, there is a "Fault type" section with radio buttons for "L1-E", "L2-E", "L3-E", "L1-L2", "L2-L3", and "L1-L2-L3". The "L1-L2-L3" option is selected. Below this is a "Result" section with "Act." and "Dev." labels and input fields.

Overlaid on the main window is a "Differential Protection Parameters" dialog box. It has tabs for "Protected Object", "CT", "Protection Device", "Characteristic Definition", and "Harmonic". The "Characteristic Definition" tab is active. It contains a graph with "Idiff" on the y-axis (0 to 9) and "Ibias" on the x-axis (0 to 90). The graph is currently empty. Below the graph, there is a "Defined Segments:" section with a list box. To the right of the list box are two checkboxes: "Auto-init Start point" (checked) and "Show Grid" (checked). At the bottom of the dialog box are buttons for "Add", "Cut from here", "Update", "Remove All" (highlighted with a red rectangle), "OK", "Cancel", and "Help".

Parameters in the dialog box:

- Idiff>: 0.30 In
- Idiff>>: 10.00 In
- Start point
 - Ibias: 0.00 In
 - Idiff: 0.00 In
- End point
 - Ibias: 0.00 In
 - Idiff: 0.00 In
- Slope: 0.00

Differential Slope Plotting

Test Object

File View Function Help

Custom
RIO
Device
Differential
CB Configuration

DIFFERENTIAL

Press Edit to view or edit this test

Edit...

I: 0 W: 0 E: 0 ✓

Fault type

☒ L1-E ☐ L1-L2 ☐ L1-L2-L3
☐ L2-E ☐ L2-L3
☐ L3-E ☐ L3-L1

Result

Act. Dev.

Differential Protection Parameters

Protected Object CT Protection Device Characteristic Definition Harmonic

Idiff>: 0.30 In
Idiff>>: 10.00 In

Start point
Ibias: 0.00 In
Idiff: 0.30 In

End point
Ibias: 1.25 In
Idiff: 0.30 In

Slope: 0.00

Defined Segments:

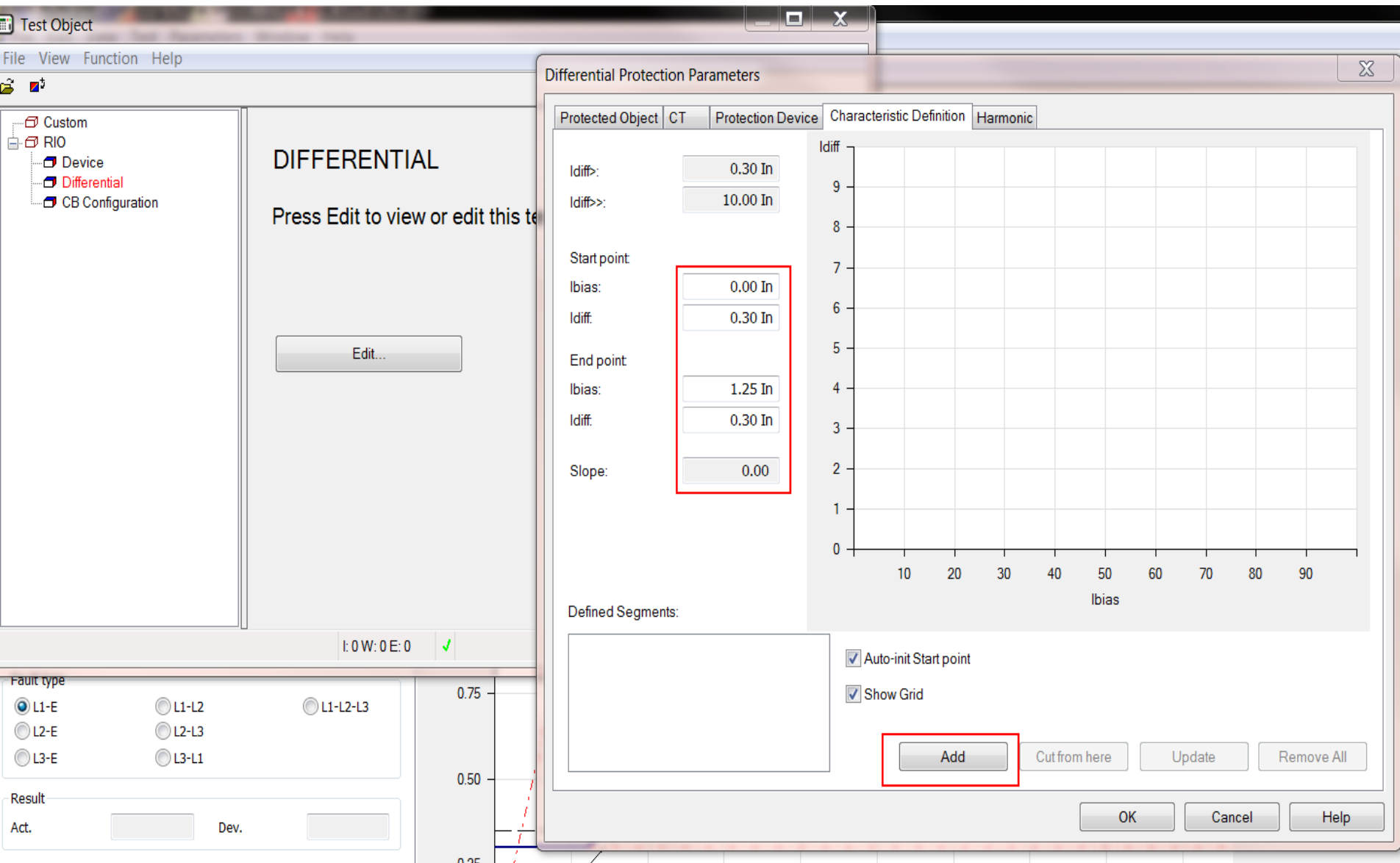
Idiff

Ibias

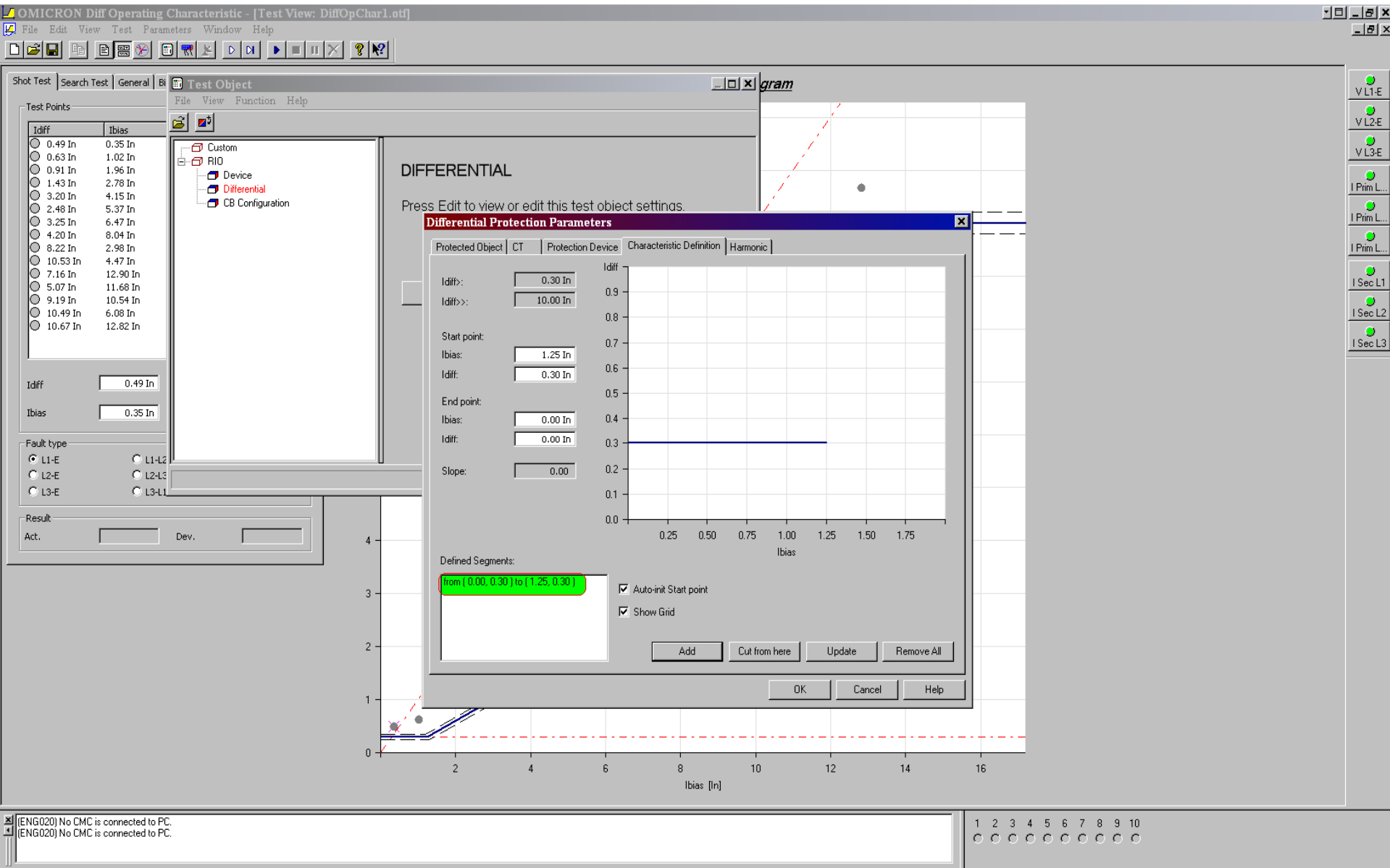
☒ Auto-init Start point
☒ Show Grid

Add Cut from here Update Remove All

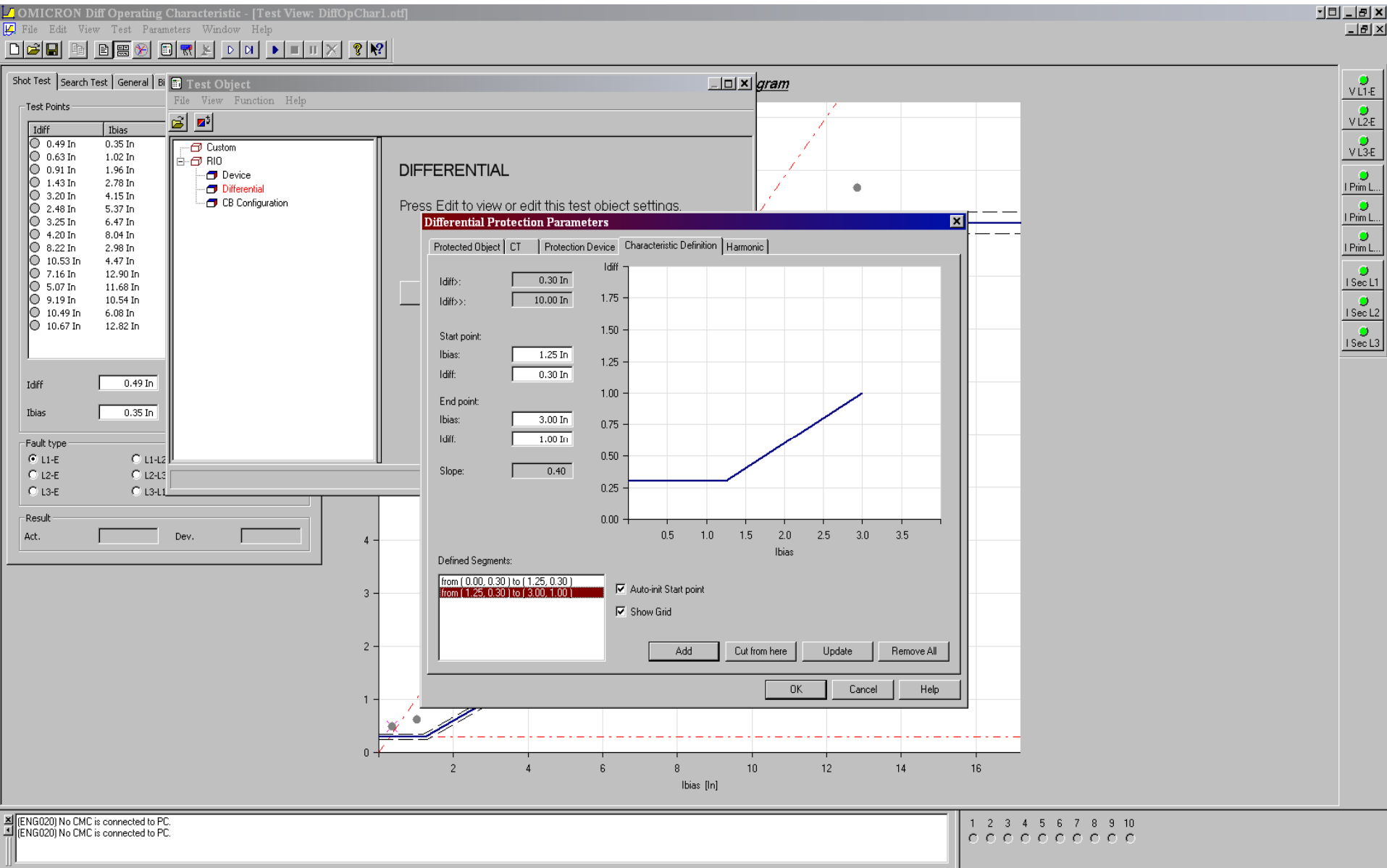
OK Cancel Help



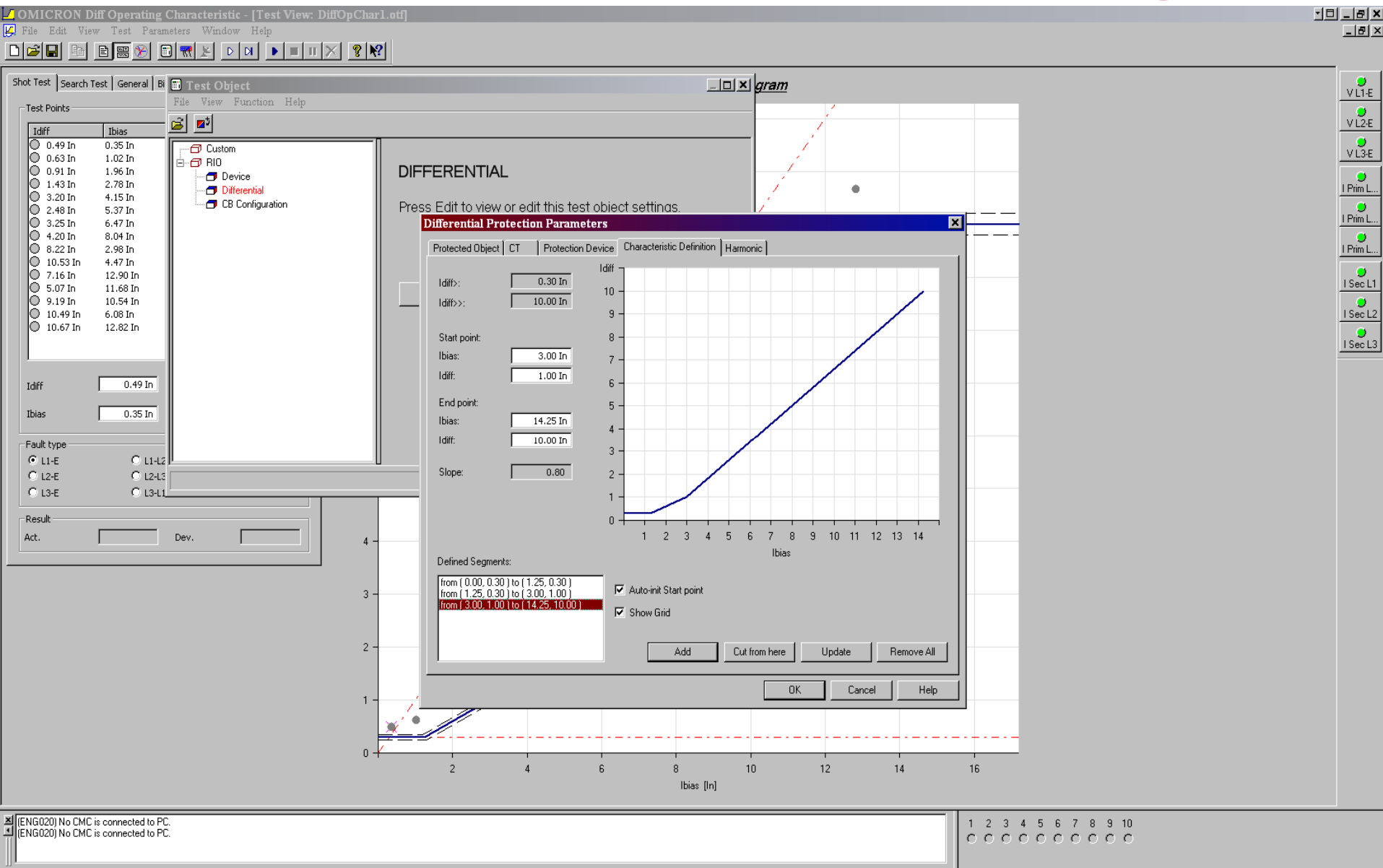
Differential Slope Plotting



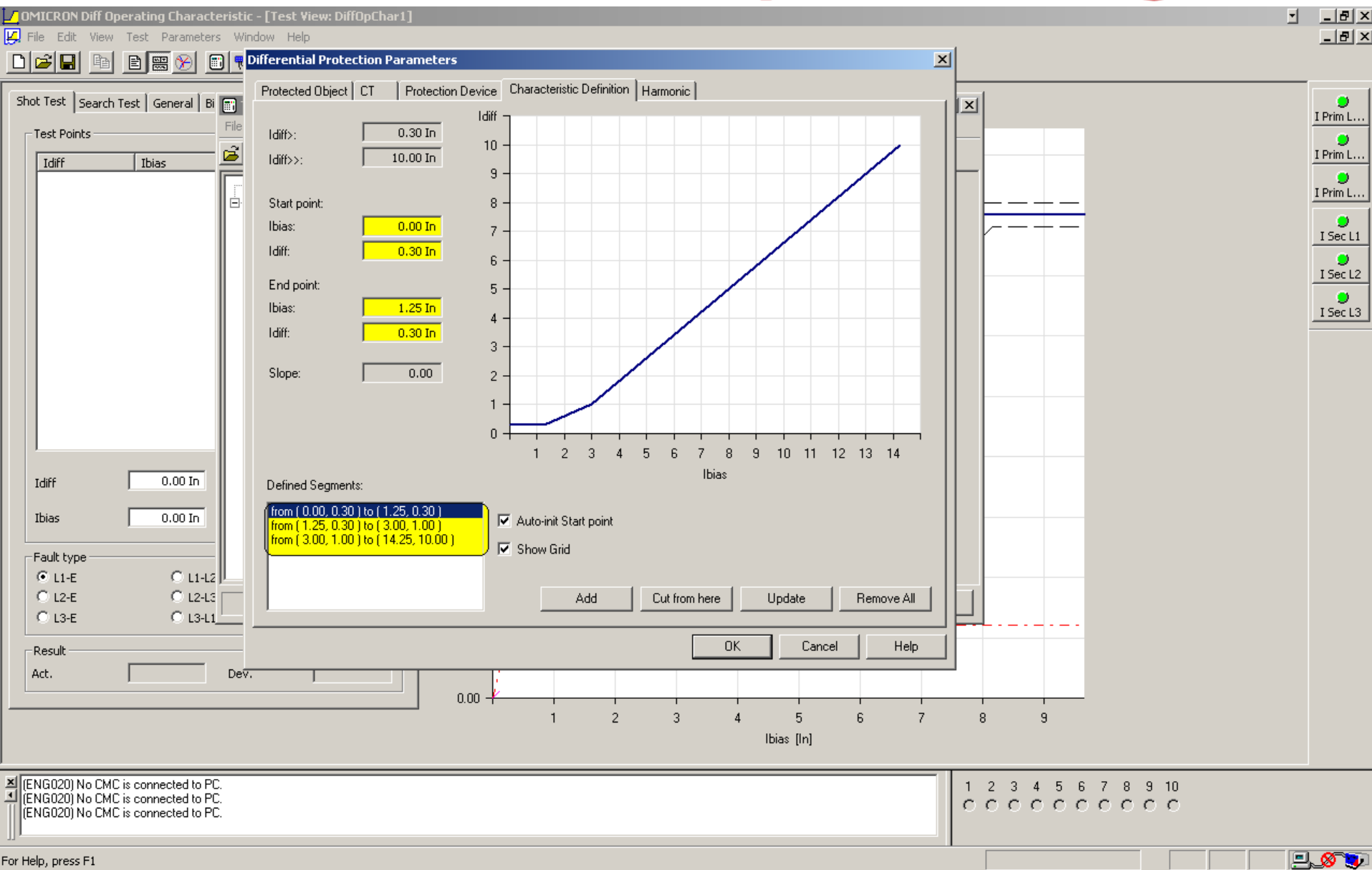
Differential Slope Plotting



Differential Slope Plotting



Differential Slope Plotting



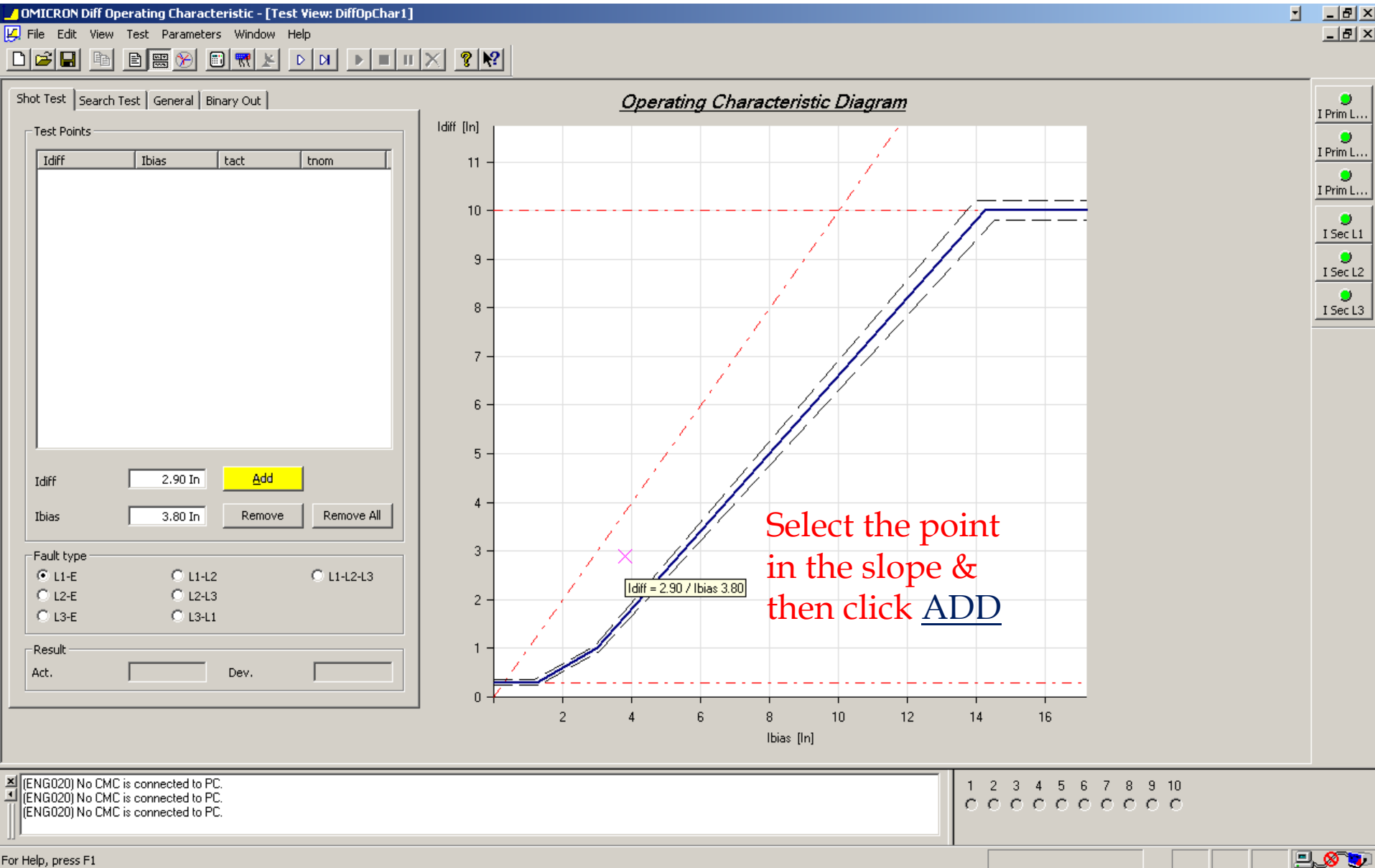


Antony RAJA, INOPC - 08/08/2013

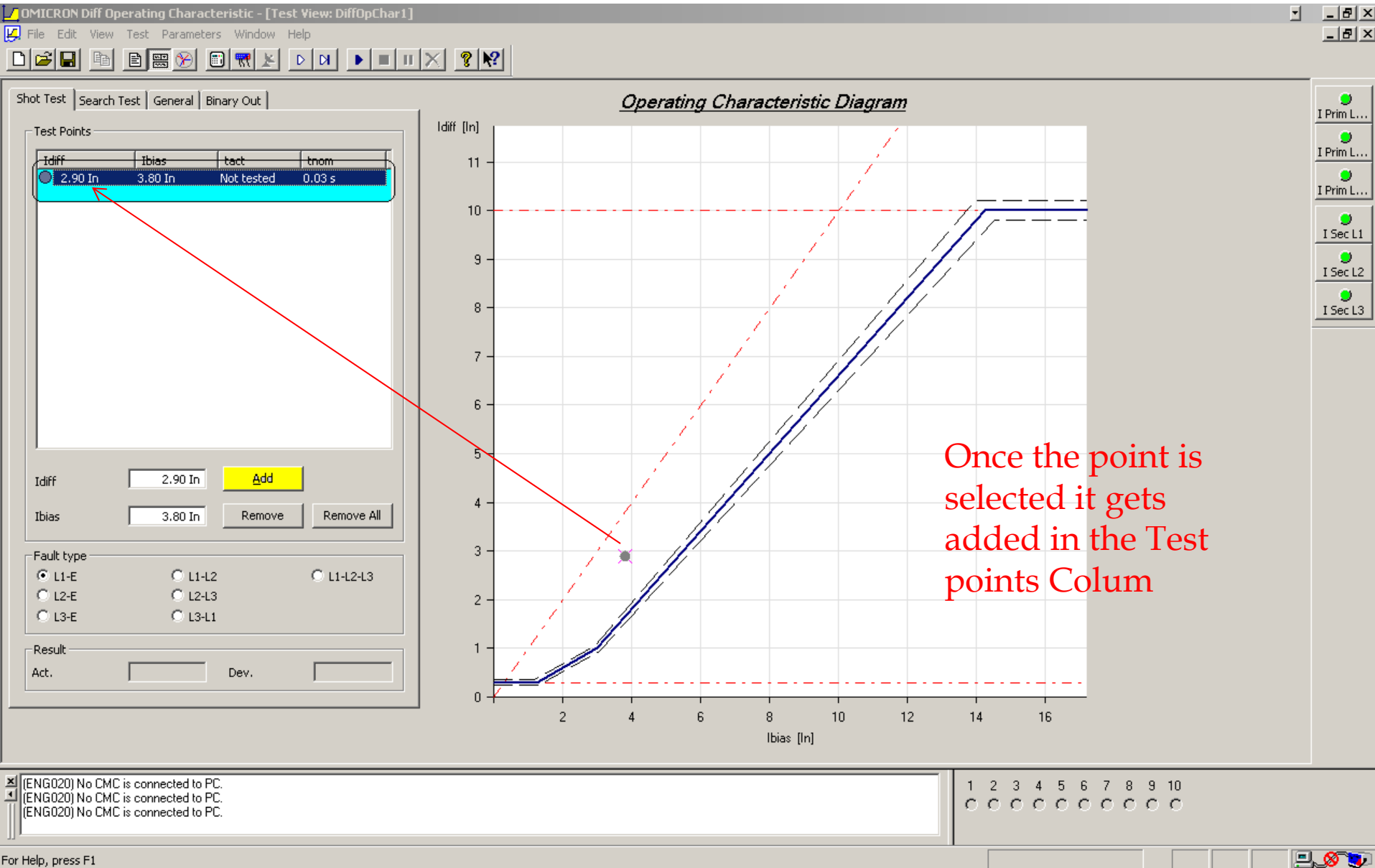
RET 670

Differential Slope Testing

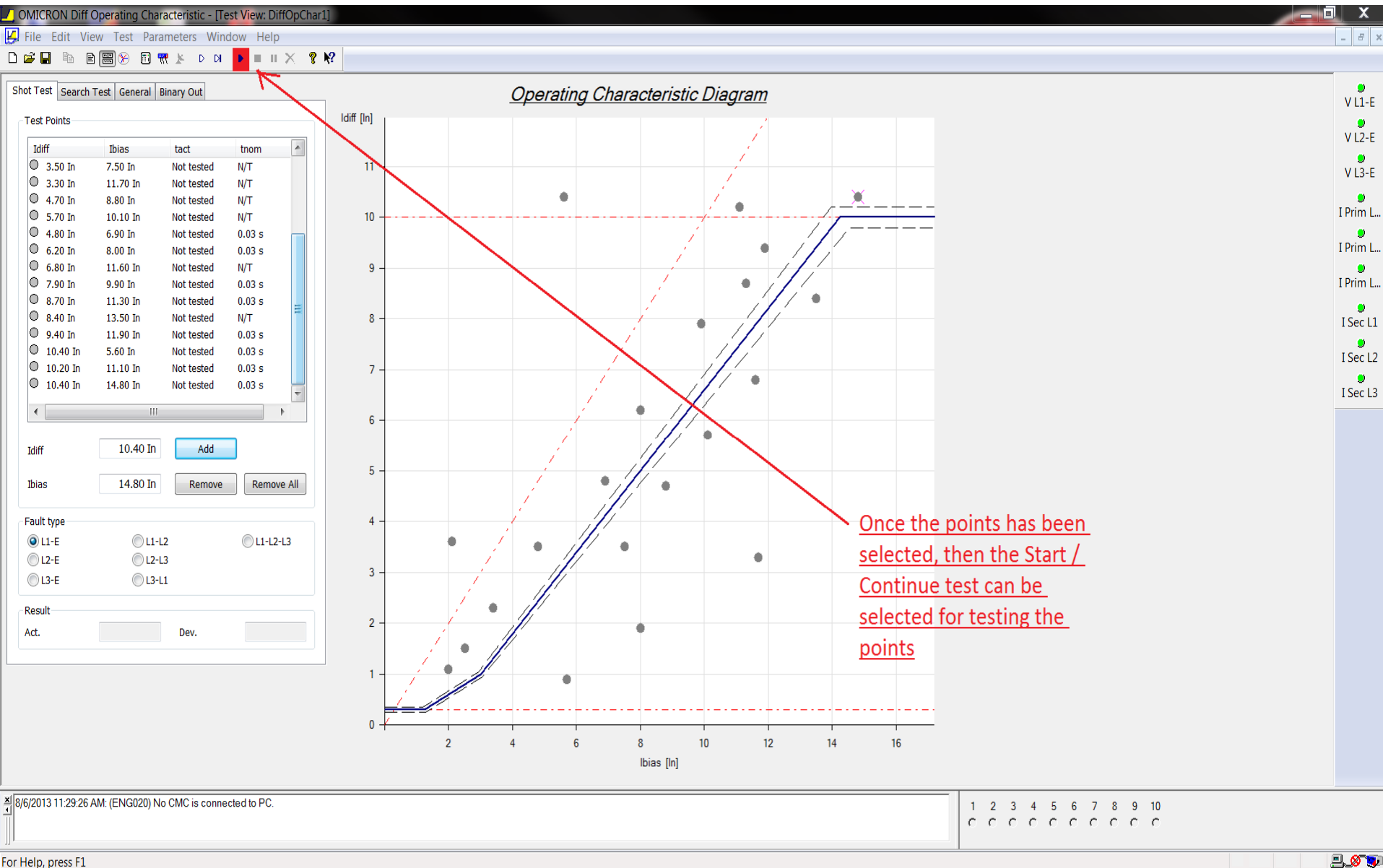
Differential Slope Testing



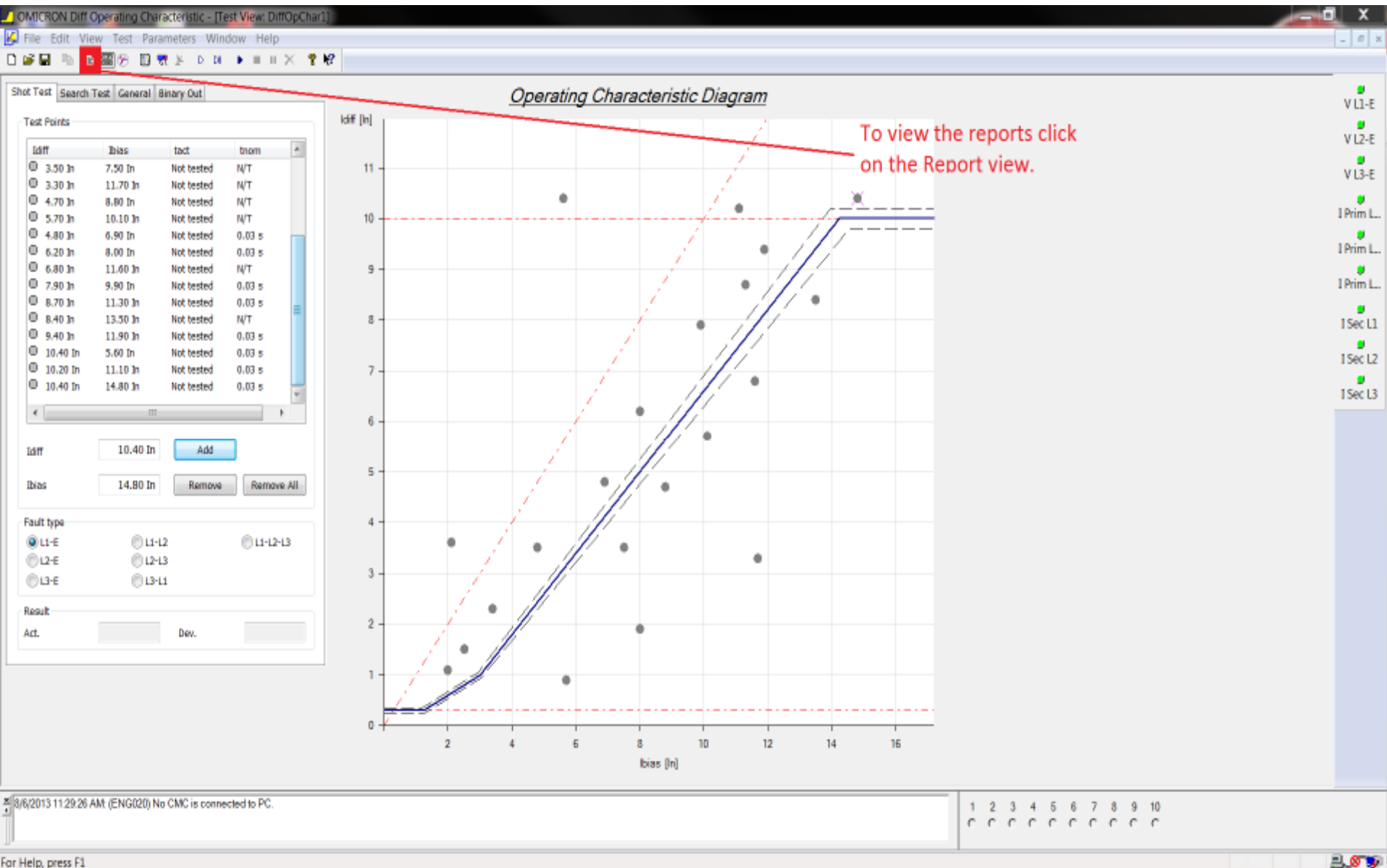
Differential Slope Testing



Differential Slope Testing



REPORT



REPORT

RET diff chara full optipn lab.otf

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YD1Y0

| Winding/Leg Name: | Primary | Secondary | Tertiary |
|----------------------|-----------|-----------|-----------|
| Voltage: | 220.00 kV | 110.00 kV | 10.50 kV |
| Power: | 95.25 MVA | 95.25 MVA | 95.25 MVA |
| Starpoint Grounding: | Yes | No | Yes |
| Delta-connected CT: | No | No | No |

CT:

| Winding/Leg Name: | Primary | Secondary | Tertiary |
|----------------------|-----------------|-----------------|-----------------|
| CT Current Prim: | 800.00 A | 2500.00 A | 3000.00 A |
| CT Current Sec: | 1.00 A | 1.00 A | 1.00 A |
| CT Grounding: | tow. Prot. Obj. | tow. Prot. Obj. | tow. Prot. Obj. |
| Gnd CT Prim Current: | 200.00 A | 800.00 A | 800.00 A |
| Gnd CT Sec Current: | 1.00 A | 1.00 A | 1.00 A |
| Gnd CT Grounding: | n/a | n/a | n/a |

Protection device:

Reference Winding: Primary
Ibias Calculation: $\max(I_p, I_s)$ (K1 = 1.00)
Zero Seq. Elimination: IL-I0
Reference Current: PO nominal current
Ground CT Used: No
Disable Comb. char.: Yes

REPORT

| | | | |
|----------------------|----------|-----------|--------|
| Disable Comb. char.: | Yes | | |
| ldiff>: | 0.30 In | tdiff>: | 0.03 s |
| ldiff>>: | 10.00 In | tdiff>>: | 0.03 s |
| ltol rel: | 2.00 % | ttol rel: | 3.00 % |
| ltol abs: | 0.05 In | ttol abs: | 0.01 s |

Test Module

| | | | |
|-------------|---------------------------------------|-----------|----------------------|
| Name: | OMICRON Diff Operating Characteristic | Version: | 2.30 |
| Test Start: | 06-Apr-2010 10:14:38 | Test End: | 06-Apr-2010 10:15:37 |
| User Name: | | Manager: | |
| Company: | | | |

Test Settings:

| | | | |
|---------------------|---------------------|------------------|---------|
| Testing: | Primary / Secondary | | |
| Max. Test Time: | 1.50 s | Delay Time: | 0.25 s |
| Prefault: | No | | |
| Prefault current: | 0.00 In | Prefault time: | 0.000 s |
| Vout enabled: | No | Vout winding: | Primary |
| GPS/IRIG-B enabled: | No | GPS/IRIG-B side: | Primary |

Binary Outputs

| | |
|-------------|---|
| Bin. out 1: | 0 |
| Bin. out 2: | 0 |
| Bin. out 3: | 0 |

REPORT

Bin. out 4:

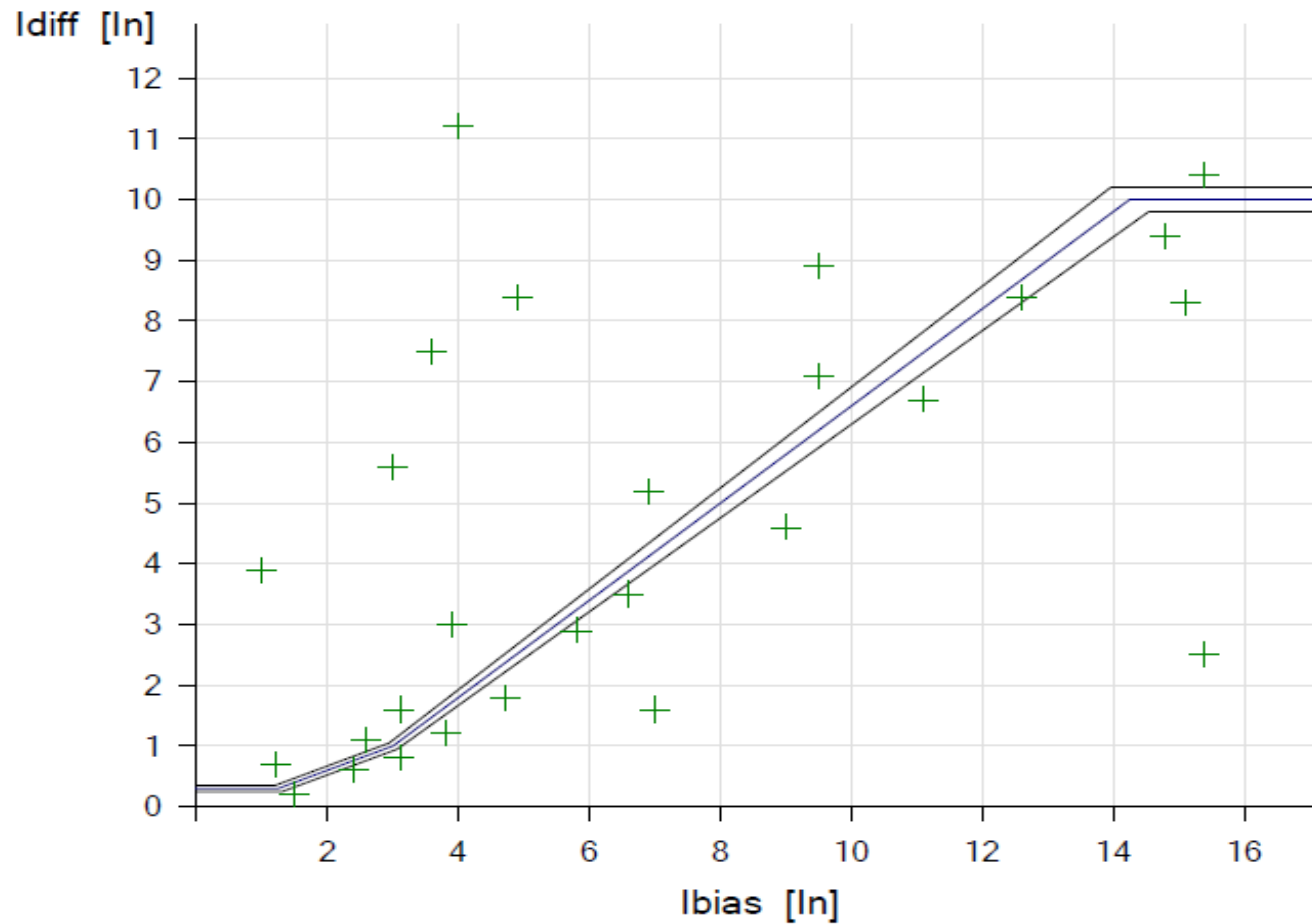
0

Test Results for Fault Type L1-E at Reference Side Primary

| Idiff | Ibias | Nominal Trip Time | Actual Trip Time | State | Result |
|----------|----------|-------------------|------------------|--------|--------|
| 0.70 In | 1.20 In | 0.0300 s | 0.0256 s | Tested | Passed |
| 1.10 In | 2.60 In | 0.0300 s | 0.0294 s | Tested | Passed |
| 1.60 In | 3.10 In | 0.0300 s | 0.0305 s | Tested | Passed |
| 3.00 In | 3.90 In | 0.0300 s | 0.0296 s | Tested | Passed |
| 3.90 In | 1.00 In | 0.0300 s | 0.0317 s | Tested | Passed |
| 5.60 In | 3.00 In | 0.0300 s | 0.0317 s | Tested | Passed |
| 7.50 In | 3.60 In | 0.0300 s | 0.0294 s | Tested | Passed |
| 5.20 In | 6.90 In | 0.0300 s | 0.0315 s | Tested | Passed |
| 8.40 In | 4.90 In | 0.0300 s | 0.0312 s | Tested | Passed |
| 11.20 In | 4.00 In | 0.0300 s | 0.0275 s | Tested | Passed |
| 8.90 In | 9.50 In | 0.0300 s | 0.0295 s | Tested | Passed |
| 7.10 In | 9.50 In | 0.0300 s | 0.0321 s | Tested | Passed |
| 10.40 In | 15.40 In | 0.0300 s | 0.0268 s | Tested | Passed |
| 9.40 In | 14.80 In | N/T | N/T | Tested | Passed |
| 8.40 In | 12.60 In | N/T | 0.0311 s | Tested | Passed |
| 8.30 In | 15.10 In | N/T | N/T | Tested | Passed |
| 6.70 In | 11.10 In | N/T | N/T | Tested | Passed |
| 4.60 In | 9.00 In | N/T | N/T | Tested | Passed |
| 3.50 In | 6.60 In | N/T | N/T | Tested | Passed |
| 2.90 In | 5.80 In | N/T | N/T | Tested | Passed |
| 1.80 In | 4.70 In | N/T | N/T | Tested | Passed |
| 1.20 In | 3.80 In | N/T | N/T | Tested | Passed |
| 0.80 In | 3.10 In | N/T | N/T | Tested | Passed |
| 0.60 In | 2.40 In | N/T | N/T | Tested | Passed |
| 0.20 In | 1.50 In | N/T | N/T | Tested | Passed |
| 1.60 In | 7.00 In | N/T | N/T | Tested | Passed |
| 2.50 In | 15.40 In | N/T | N/T | Tested | Passed |

REPORT

Operating Characteristic Diagram



| | | | | | | |
|------|---|---|---|---|---|---|
| Shot | 1 | 2 | 3 | 4 | 5 | 6 |
|------|---|---|---|---|---|---|

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